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CONTENTS.

An Asterisk (*) denotes an illustrated article.

OFFICIAL NOTICE—
Eighteenth Annual Meeting American Gas Light Association..... 397

EDITORIALS—
Briefly Told..... 398
Personal: W. A. Stedman—An Interesting Suit, Denver, Col.—Sale of the East Chester (N. Y.) Works—Notes.
*Duplex Gas Engines, by Mr. Elmer A. Sperry..... 399
Decay of Boilers..... 400
*A Combined Washer, Tar Extractor and Exhaust Regulator, by Mr. E. G. Saville..... 400
Notes on Gas Lighting and Gas Fitting, by Mr. William Paul Gerhard, C.E.—Continued from page 364..... 402
The Education of an Engineer..... 403
Specifications for Cast Iron, Coated Water Pipe, by Mr. T. W. Yardley..... 405
ITEMS OF INTEREST FROM VARIOUS LOCALITIES..... 406
Hints from Greensboro, N. C.—Gas Works for the Monticello Seminary—Leased—Mr. Douglas on the Outing Programme, Savannah Convention—San Francisco Gas Companies—Public Lighting, Birmingham, Ala.—Cheaper Gas, Port Henry, N.Y.—The Bidelman Gas Process—Will the Jefferson City (Mo.) Gas Company Take up Electric Lighting?—A Busy Firm—Public Lighting, Halifax, N. S.—Annual Meeting, Jamaica Plain, Mass.—Coke at St. Louis, Mo.—Incapable Authorities at Pittsburgh, Pa.—And Many Other Items.
Practical Nationalism at Chicago..... 409
The Market for Gas Securities..... 410

[OFFICIAL NOTICE.]

Eighteenth Annual Meeting of the American Gas Light Association.

EXTRACT FROM THE CONSTITUTION:—Sec. 12. *Application for Active Membership, or for Associate Membership, or for transfer from Associate to Active Membership, must be received by the Secretary at least ten days prior to the meeting at which the application is acted on.*

SECRETARY'S OFFICE, Aug. 25, 1890.

To the Members of the Association: Gentlemen—The rapidly approaching autumn serves to remind us that the time for the Eighteenth Annual Meeting of our Association is drawing rapidly near, and it is therefore proper that I should inform the members of the arrangements which are being consummated, whereby we hope the meeting will be made one of the most successful gatherings we have ever had; certainly it deserves to be such, for it will be the first time we have ever gone to the extreme South to hold our annual convention. Already there are indications that the coming meeting will be a very large gathering, and it is proper and natural that it should be; for as many of our Southern members have been very faithful in their attendance at our annual gatherings, when held at the North and in the West, it is but just courtesy that the brethren from the cooler sections of our territory should make an extra effort to be present on this first occasion of our coming together in the South. And, further, the South is a section of the country through which many of us have not traveled so thoroughly as we have in the North, and it is therefore but natural that we should all be only too anxious to improve this opportunity to make ourselves better acquainted with Southern people and the Southern land, for the novelty of the surroundings in the South will add a peculiar charm to our trip. Savannah is a typical Southern city, and one particularly suited for the holding of our convention. Situated on the south of the Savannah river, and within 12 miles in a straight line from the coast, it has many advantages of both an inland and seaboard city. The river in Tybee Roads has a depth of 31 feet at low water, thus admitting the ocean steamers to come up direct to the wharves of the city; hence it will be possible for such of our members living in the vicinity of Boston, New York, and Philadelphia, who enjoy an ocean sail, to take a steamer from either of the cities named and land right at the heart of the city.

Savannah is a very pretty city and has many attractions peculiar to itself; laid out as the streets are in rectangular lines, they are pleasantly broken by many small but pretty parks—in fact there are between 20 and 30 of these attractive gardens scattered throughout the city. In the southern part of the city is Forsyth Park, with a fountain after the model of that in the Place de la Concorde, Paris, and a monument to the Confederate slain. Johnson Square contains a doric obelisk of General Green and Count Pulaski, the corner stone of which was laid by Lafayette; and in Monterey Square, on the spot where Pulaski fell, in 1779, rises a more elaborate monument—a statue of Liberty. Many of these parks are semi-tropical in their vegetation, and will have to many Northerners the charm of novelty; and in this connection should be mentioned Bona-Venture Cemetery, with its live oaks dressed in Florida moss—at once a beautiful and novel sight. It is also to be noted that Savannah is one of our largest cotton shipping ports, and our members will have the opportunity of seeing the loading of cotton vessels going on with all its hustle and bustle; the sight of men stowing away a cargo of cotton, with the help of huge jacks, will certainly be new to many of the visitors. We will also be fortunate this year in having hotel accommodations such as we have not had at any previous convention. The De Soto—the headquarters selected—is a new hotel and is a good rival of the magnificent hotels which have lately been built in the South. The De Soto occupies a prominent corner in the central part of the city, in fact covers the site on which—as old army men will well remember—stood the old arsenal used as the headquarters of the Union forces during Sherman's occupancy of the city, and is built in the form of a hollow square, in the center of which is the parade ground; the front of the building measures 222 feet, while it extends 302 feet to the rear; the dining hall, which is beautifully finished, is 44 feet by 120 feet, and looks out upon Liberty and Drayton streets on two sides, the windows of the third side opening out upon a veranda overlooking the parade ground and tennis courts. The service of the hotel will also be of the best; the committee of arrangements are giving this matter particular attention, and, as the house will not be at all crowded, members can depend upon finding everything thoroughly comfortable. The rate which has been secured at the hotel for the members of the Association and their friends is $3.50 per day, board included, with a discount from this price if the attendance is large. It is hoped that all the members will stop at the De Soto, because by so doing they will help to swell the number and thus aid in securing the lowest rate. It is to be remembered that though the rate is thus made very low—considering the character of the hotel—nevertheless the accommodations will be first-class and such as they would offer to their regular guests. It is hardly necessary to add that private parlors and bath rooms will be charged for extra, as is the case in any American conducted hotel.

I have thus gone into a description of the hotel with more than regulation precision, because I fear some of the members may feel that as Savannah is not a city of the first magnitude, the hotel accommodations might be of an indifferent nature; whereas the fact is we may expect to be taken care of far better than we have been in the past, even in the largest cities. The meetings of the Association will be held in the spacious banquet hall on the top floor of the hotel; we will thus have both a cool and a quiet hall.

The meeting will be called to order by President McMillin, on Wednesday, October 15th, at 10 A.M., and will continue through the two following days. The papers already promised are as follows:

"The Extension of the Use of Gas for Purposes other than Illumination," by E. G. Pratt, of Des Moines, Ia.

"The Mismanagement of Gas Works," by E. G. Cowdery, of Milwaukee, Wis.

"Gas Coals of the United States," by H. C. Adams, of Philadelphia, Pa.

"The Practical Efficiency of an Illuminating Water Gas Setting," by A. G. Glasgow, of Philadelphia, Pa.

"Inclined Retorts," by Frederic Egner, of St. Louis, Mo.

"The Gas Engineer and his Pencil," by F. H. Shelton.

"Purification of Gas," by A. E. Forstall.

"Suggestions of Methods and Systems for Recording the Histories and Accounts of Gas Light Companies, by Wm. P. Fodell.

From the above it will appear that we have eight good themes for special study and discussion. In this connection I would say that if a member has any matter upon which he would like to write a paper, we can probably find room for one more essay. I would also issue my usual invitation for members to send in queries for the question-box; it is well to have these in advance, in order that we may have someone prepared to lead off in the discussion.

On the evening of Thursday, the second day of the meeting, the Association will be the guest of the Savannah Gas Company, at a banquet which will be given at the De Soto; it is expected that in addition to the members of the Association there will be present many of the leading citizens of Savannah to grace the occasion. Efforts are being made to have a river excursion on the last day of the meeting.

We expect to have the regular rebate on railroad rates, particulars in regard to which will be given later, when I have received detailed information from the railroad authorities.

I wish to impress upon the members that Savannah is easy of access from most of the large cities of our country; for instance, leaving Boston at 7 o'clock Sunday night, we would pass through Washington at 11 the next morning, reaching historic Richmond at 2.30 the same afternoon; an hour later we reach Petersburgh, ever famous since the war; Charleston we will see by the early daylight, and at 6.44 Tuesday morning we should be at Savannah. Or those who do not care to spend so much time away can leave Boston Monday night and reach Savannah a few hours before the opening of the convention. Leaving New York at midnight of Sunday or Monday, Savannah would be reached on Tuesday or Wednesday morning respectively; while the run from Philadelphia takes less than 24 hours. From Chicago one route is over Illinois Central to Cincinnati, thence by Queen and Crescent, Western and Atlantic and Georgia Central; time, 39 hours. Time from Cincinnati, 34 hours. From St. Louis, via Louisville and Nashville, and Nashville, Cincinnati and St. Louis, and Western and Atlantic, and Georgia Central; time, 34 hours.

Thus it is apparent that the run to Savannah from the centers, at which the members will be apt to congregate before starting South, is not a long one, and as the route much of the way lays through interesting sections of the country, with pine forests and beautiful rice fields, and through places made historic by the war, the journey ought to be a pleasant one. If the members desire to charter special cars, I will gladly help them in any way I can. Or those preferring an ocean trip can take one of the ocean steamship company's vessels from New York or Boston and land right at the city, the trip taking from 48 to 55 hours. The rate by this route, including meals and berth in state room—first-class—is, from New York $15, or $25 for the round trip; from Boston the rate is $17 one way, or $29 for the round trip. Those desiring to secure these special rates must obtain a proper certificate from me.

Finally, I wish to urge upon each and every member that he endeavors to be present and make this meeting a grand success. We meet for the first time in the South; we have for our President one of the most popular men of the West; these two facts should lead all to make an extra effort to attend. Not only so, but it is particularly desired that the members will bring their ladies with them, as the committee are making special arrangements for their entertainment. Already a local committee of reception has been appointed from among the hospitable ladies of the city, so there will always be escorts at hand to show the attending ladies the places of interest throughout the city, of which there are many more than I have space to enumerate. Anticipating the attendance of a large number of ladies, the hotel proprietors have placed at the disposal of the local committee of ladies the large parlors at the Bull street entrance of the hotel, and they will be for the exclusive use of the ladies attending the convention. In fact it may be said the entire hotel will be at the disposal of the members and their friends.

Yours truly, C. J. R. HUMPHREYS, Sec'y.

LAWRENCE, MASS.

BRIEFLY TOLD.

OWING to the failure to bring about a consolidation of the gas interests in Rochester, N. Y., and the seeming improbability of uniting the three companies under one management, Col. W. A. Stedman has resigned the Superintendence of the Rochester and Municipal Companies, and has resumed his residence at Newport, R. I.

A MOST interesting case is reported from Denver, Colorado, which originated in an application from one E. F. Hallack to Judge Allen, for a mandamus against the Denver Gas Company, to determine whether or not defendant had the right to discriminate in its charges as between those who use gas exclusively, and others who use gas and electric light. The gas and electric light interests of Denver are in opposition, and it is the practice of the Gas Company to charge $1.50 per 1,000 to its customers that use gas only for illumination, while those who use both gas and electricity are obliged to pay $2 per 1,000 for their gas supply. In the first hearing before the Court the proceedings hinged on a motion by plaintiff's counsel to strike out some parts of defendant's answer to the petition. Summed up briefly, the facts and action so far taken are as follows: The plaintiff averred that he had taken gas from the Company for lighting purposes for several years, but afterwards employed electric lamps for lighting, and used the gas for heating and cooking—in very small quantities, however. After the change was made, when his first bill for gas was due, he offered to pay the Company for the same at the rate of $1.50 per 1,000. The Company replied that its charge to users of small quantities of gas was $2 per 1,000, and refused the tender. On January 4, 1890, the Company removed its meter and declined to supply plaintiff with gas on his terms. He then brought suit for $5,000 damages. The Company, in answer, said that owing to the damage sustained in competition with electricity it had been compelled in self-defense to make a discrimination in rates, holding out the lower one as an inducement to consumers to use gas only, and that as plaintiff did not see fit to avail himself of that chance, the Company had the right to charge him the higher price, and to remove his meter for his refusal to accept its terms. Plaintiff also claimed that the Company had no right to take competition with electricity into account in the fixing of its charges. Judge Allen, in finding, said, in substance: A corporation is a public concern, bound to supply gas to the public, and to make itself able to meet the demands upon it by consumers for a *reasonable* and *proper* use of its commodity. If plaintiff required the respondent to place a meter in his dwelling, and to supply with gas the pipes he had placed there, he must give assurance that he would use a reasonable amount. If the plaintiff came to the conclusion that he did not want to use gas after a certain time, and would give no assurance that he would so use it, the respondent was not obliged to continue to supply gas. If plaintiff only saw fit to use it one month out of twelve, that was not reasonable use. Besides, it was just for the Company to set different prices in regard to the amount used. A slight increase of price such as respondent made was not unreasonable where the use was limited. The matter of competition with electricity was extraneous to the issue. The reasons why plaintiff did not use gas continuously were also foreign. He could not expect to depend on electricity and demand respondent to keep a supply of gas in his pipes to be used as a substitute to fall back upon in case of accident. Counsel for plaintiff asked whether it made any difference in case he used the gas for heating or illuminating purposes, and the Court replied in the negative. The matter will now come up for trial on its merits, and it looks to us that defendant must gain the verdict.

RUMOR has had it for some time back that capitalists were looking toward the purchase of the franchises and works of the East Chester (N. Y.) Gas Company, a plant that has for about 19 years been managed with the discretion and capacity that have always marked the business career of Mr. Charles Nettleton, of this city, whose name will remain for all time linked with the gas industry of this country from his incumbency of the position of Secretary of the American Gas Light Association. Once again did rumor tell the truth, for the East Chester works were sold about a fortnight ago to the American Gas Company, of Philadelphia, and the purchasers are now in possession. The growth of the gas business in this country is well exemplified in the history of the East Chester Company, which, when it passed into the hands of Mr. Nettleton, was in anything but sound financial position. However, thanks to his energy and fostering care, ably aided by his co-adjutor, Mr. Philip Lucas, prosperity became its portion when their hands were placed upon the tiller. From an annual make of less than 2,000,000 cubic feet, they have seen it grow until the annual sendout mounted well up into the 20 odd millions, the plant being maintained out of good, hard earnings, with a capital stock in which no water found a resting place. The reasons for selling were: A fair figure on the investment and the knowledge that many thousands of dollars would soon have to be put out in plant betterment, to meet the rapidly increasing demands of a fast augmenting population. Mr. Lucas remains with the Company, and Mr. Nettleton must not be considered as having retired from the active ranks, for he still holds important ownership in one or more gas enterprises.

FIGURES from the books of the Consolidated Gas and Electric Light Company, of Batavia, N. Y., show that the sendout of gas for the past twelvemonth is fully 15 per cent. greater than that reported for the preceding year.

SOME three years ago the charter of the old Jackson (Mich.) Gas Light Company expired by limitation, and the major portion of its possessions was purchased by the proprietors of the opposition works. The remnant of its property will be disposed of to-day, at public auction, Judge Beck having issued the order authorizing the sale.

JOSEPH CUMMINGS, of 1344 Wabash avenue, Chicago, Ills., was convicted recently in Justice Prindiville's court of having tapped a gas main of the local Company, thereby securing a supply of gas without paying for the same.

THE city law department of Chicago has given an opinion to the effect that the corporation, under the existing statutes, has no right to regulate the rates for telephone service within the city limits. Under this construction, the city would, therefore, seem to be equally powerless to regulate gas rates.

BE the above as it may, it is asserted by some, and denied by others, that, through an agreement between the authorities and the Chicago Gas Company, gas rates in Chicago will be put at the uniform rate of $1 per 1,000 cubic feet—a reduction of 25 cents per 1,000 to ordinary consumers, the city paying an equal sum—the reduction to take effect on October 1st. It is also hinted that the rate for each gas lamp will be cut to $18 per annum, against the ruling rate of $20. These are very low figures.

]Prepared for the JOURNAL.]

Duplex Gas Engines.

By MR. ELMER A. SPERRY.

It was Professor Fleming Jenkin who first gave to the world the mathematical demonstration of the increased economy attending triple and quadruple expansion in the steam engine. Prof. Thurston, in this country, in his recent paper on steam engines for electric lighting, has pointed out the extremely high theoretical attainment of the latest forms. He says that in fact these have now arrived "To so perfect a condition that the range for further improvement is probably very narrow, and the gain still to be made must come slowly and painfully." The first named eminent authority has further made the statement that "The achievement of the steam engine has nearly reached the limit of the possible."

The efficiency of the steam engine, when taken as a measure of the recovery of power from the total power-equivalent of the heat employed, following the most improved methods, is only about 10 per cent., when large units of power are considered. To compare this performance with that of the gas engine, it is but fair that we take equal units in either case. In the comparison of the two motors as heat engines, size for size, the actual performance of the gas engine is over 200 per cent. better than that of the steam engine, with a vast unexplored region beyond in the case of the former, giving promise of great improvement and higher economy than the most excellent performance yet recorded.

In considering the great problem of transforming heat energy into mechanical and electrical energy, it may be well to investigate the laws of operation and working of a system that has already realized so much in the direct line of transformation of heat into mechanical motion.

The gas engine is a hot air engine in which the air as it is drawn into the cylinders is charged with a substance which may, at the proper moment, yield the heat required to increase the bulk, the confining of which develops the pressures utilized in moving the piston. This increase of bulk on ignition, and the corresponding pressure of the air, is from four to five times. Thus, if the air or mixture in the cylinder at the time of ignition is 40 pounds, the pressure resulting from ignition is about 200 pounds. The ignition does not cause an explosion, as is usually supposed; but, on the contrary, the inflammation goes forward until a certain pressure and temperature is reached, and at this point is arrested, and further inflammation is developed as the piston goes forward and the pressure thereby tends to decrease. The writer has seen cards from gas engines in which constant pressure was developed throughout nearly the entire stroke. This is especially the case with lean mixtures, or below 11½ to 1 of ordinary illuminating coal gas.

"This system of transferring the furnace, wherein the energy is primarily developed, into the cylinder of the engine itself and there utilizing directly the benefits of combustion, is undoubtedly the greatest step in advance of the present half century in the direction of high economy and efficiency. There is no doubt but that the engine of the future is to have its furnace in its cylinder, thereby eliminating the gigantic waste attending latent heat, which is encountered in the use of steam. The high performance of 1.4 pounds of coal per horse power per hour in a 10-horse power engine compares favorably with from 7 to 12 in the steam plant of equal size.

This being true, the question is asked, "Why are not gas engines more sought and employed for ordinary power purposes?" The answer to this question can only be found by a study of the performance of the present gas engine, noticing the difficulties encountered and the limited application to the more exacting power consumers, and the devices resorted to in the attempt to overcome some of these difficulties. The greatest evil of the present method and cycle of operation in the gas engine is the want of uniformity of speed in the power developed. This is owing to the fact that usually but one out of four—frequently one out of eight—of the strokes or units of power is available for producing effective results. The others are not only non-productive, but actually consume the energy developed in the one. It is true that engines have been produced that give every other stroke an effective stroke; but this system at best produces irregularity that renders it indifferent for driving more delicate machinery, especially electrical generators for lighting purposes. It is true that dynamos may be driven by existing engines to supply storage batteries with some degree of success; but where direct illumination is required the noticeable irregularity and throbbing prohibit their general adoption.

The gas engine of to-day undoubtedly stands in the same position as the steam engine in 1860, when Charles T. Porter first proposed to develop double or triple the power from the same weight of material for the same weight of engine by increasing the number of its power producing elements, per minute, from 50 strokes—as was the practice—to 250. Or, to follow history in steam engineering still further back, in the days of Newcomb and Crawley, when all cylinders were single-acting, and a multiplication of cylinders was required to increase the number of power strokes.

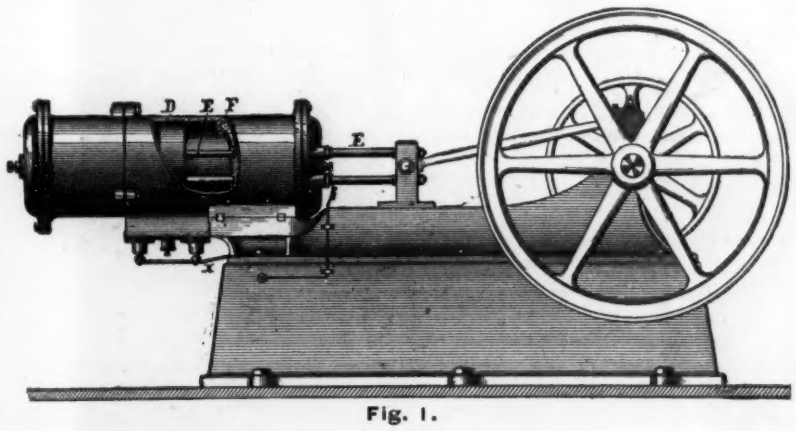


Fig. 1.

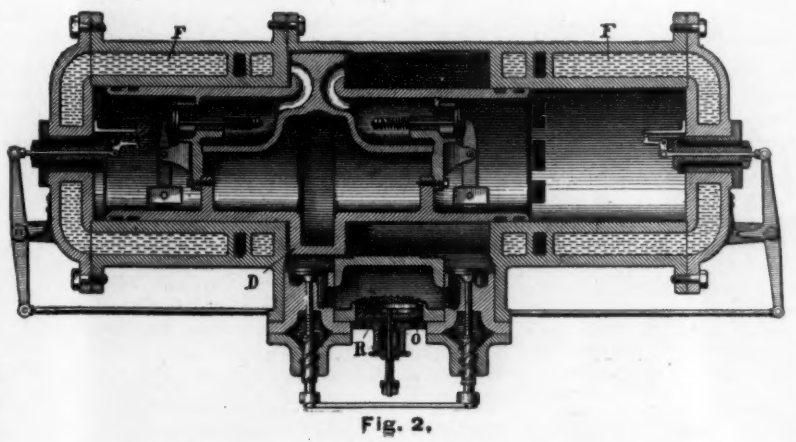


Fig. 2.

The commercial gas engine of to-day has a single-acting cylinder. The difficulties of packing against the high temperatures have been found, and probably will remain insurmountable. French engineers have sought in vain, through long continued and expensive experiments, to find methods of packing a piston-rod against the high temperatures of the cylinder, and thus to produce a double-acting engine. The American engineers have heretofore tried, but thus far have failed, to produce a double-acting gas engine.

The most successful practice in gas engines has been followed in producing the engine illustrated herewith; that is, single-acting combustion cylinders are used, which are placed opposite to each other, and form a single mechanical element. Midway between them is a cylinder of larger bore, performing the office of a pump for transferring the mixtures to their proper destination before combustion. The compound piston, which reciprocates in these three cylinders, is also a single mechanical element, the two ends being of similar size, forming plunger pistons operating in the combustion cylinders, in the middle of which is located an annular enlargement, *D*, which fits the larger bore of the pump cylinder. The differential area so produced between the combustion piston and the pump cylinder is the area which is available for transferring the gases, and forms the piston area of the pump cylinder. It is to this element—namely, the annular shaped pump piston—that the main piston rods *E*, two upon each side, are attached, as may be seen in Fig. 1, thereby eliminating the necessity of packing against the high temperatures; the only packing required in the piston-rods is against the low pressures of the cold mixtures within the pump. It will be seen, by Fig. 2, that the two combustion cylinders are at opposite ends of the compound cylinder. The water jackets are shown at *F*. Along and parallel to the front cylinder are the cored passages *G*, in which the two

piston-rods *E*, connecting with the cross-head, reciprocate. (See Fig. 1.) The packing glands *I* are required to pack only against the small pressures of the gases in the pump cylinder. This pressure is so slight as to be wholly disregarded.

The law of operation or cycle of the engine is as follows: The pump is double-acting, and is provided at either end with an induction valve, below which is a screw, by turning which the seating of the induction valve may be varied. This varies the pressure within the pump, and, therefore, the amount of mixture transferred into the combustion cylinder previous to ignition. The ignition is performed by the electric spark, the two igniters being coupled in multiple arc.

The mixing device is peculiar and extremely simple, and consists of a valve, *O*, covering both gas and air passages in a perforated plate. This valve is so large as to nearly fill the circular space in which it is contained, leaving only a very narrow circular slot at its periphery. The gas and air, as they are drawn through this narrow slot, are given a very high velocity by the suction of the pump at either end. A wire gauze diaphragm, *R*, stands immediately in front of this passage and completely breaks up the rushing gases as they emerge from the slot. These as they reunite form a most intimate and complete mixture. Experiment has shown that this mixture attains almost theoretical perfection, aiding materially in the perfection of combustion and economy attending the operation of the engine. The compression of the engine is from 35 to 45 pounds, before ignition, when the engine is working near its capacity, and from this figure down to atmospheric compression when working less than its rated capacity. A governor on the axle is connected by rod, *X*, to the two screws beneath the induction valves, and thereby automatic regulation is obtained, which is found in practice to hold the engine within 3 per cent. from full load to zero.

The actual performance of the engine is very high, being from 19 to 21 cubic feet per horse power. The perfect uniformity of speed is owing to the fact that every stroke is effective, and a comparatively small weight of engine is required to the horse power. Chief among its merits is its low cost of manufacture.

A 13-horse power engine of this make weighs only about 1,900 pounds, and requires but a small fly wheel; and, for purposes of driving dynamos, the fly wheel may be used for band wheel, about the same practice being followed as in steam engineering in determining the weight of these elements.

The Engineering Department of the Patent Office looked upon this invention with unusual interest, owing to the fact of its being the first system of construction which rendered the double acting gas engine feasible, and a patent containing some 65 claims was granted upon same.

Decay of Boilers.

The *Machinist* asserts that many explosions of boilers would not have occurred if closer attention had been given to the deterioration of the boiler caused by the general or local decay of the material. A boiler when new may have a factor of safety of 6; but it must be remembered that with the beginning of the life of a boiler decay also begins, and that the original margin of safety is gradually reduced by the ever progressing decay caused by corrosion; and if this decay is allowed to progress too far an explosion is sure to take place.

Corrosion does not always attack the surface of steel and iron plates in a uniform manner, hence the decay is more likely to be local than general. This difference in corrosion is probably due to the structural difference in the plates; they are not always perfectly homogeneous, being prevented from becoming so by the nature of the processes of manufacture. For instance, the fibers of iron are welded together by squeezing, hammering and rolling, which sometimes allow the fibers to be separated by thin layers of impurities. The innumerable air and gas cells in steel ingots, more or less perfectly welded together by hammering and rolling, also prevent a perfect homogeneous structure; and it is fair to assume that the imperfect structure of the material is one of the causes of local corrosion. But in steam boilers there are other causes for local decay; for instance, a thin scale tends to protect the plates, but this scale often becomes detached in local places, leaving the clean iron exposed to corrosive action which rapidly progresses. Again, the fibers of the metal may have been loosened by bending, hammering, etc., all of which tends to accelerate corrosion.

Plates are affected in various ways by corrosion; frequently small cavities are formed in the plate, the depth varying from a shallow depression to an actual perforation of the plate. In some cases the cavities lie far apart; in others they are close together, giving the plate a honeycombed appearance. This phenomenon is called pitting, and may be caused by surface defects due to cinder spots, etc., but frequently it is due to the intense local action of fatty acids, or other particles of corrosive substances; in some cases the cause of pitting is attributed to the galvanic action of particles of heterogeneous metals.

From the foregoing it appears that, to prevent pitting, good material only should enter into the construction of the boiler, and if pitting then occurs, the water should be analyzed, and, if necessary, changed; and greasy substances should not be allowed to enter into the boiler.

Frequently the corrosion forms deep furrows parallel and close to the seams; this phenomenon is called grooving or furrowing. In nearly every case this furrowing occurs under the water line, and in horizontal boilers with lap joints; the grooves are deepest along the horizontal seams. Probably the chief cause for furrowing is a chemical action, because it does not occur with all kinds of water, and it rarely occurs above the water line. But this chemical action is accelerated by a mechanical action which tends to change the form of the shell of the boiler, bending or springing the plates along the seams; but the bending of the plates may break off the incrustation, or even the outside scale of the plate itself, thus continuously exposing a fresh surface of the metal to the chemical action of the water.

The mechanical action may be due to the constantly occurring variation of the pressure, as steam is made or blown off, or it may be produced by the changes of temperature; and if this change of form goes on continually, though ever so slightly, along the same line, the mechanical action of itself must finally produce rupture.

Furrowing is often due to the carelessness of calking, by which the skin of the under plate is cut; careless workmen should not be permitted to use a calking tool.

[A paper read before the Manchester District Association of Gas Engineers.]

A Combined Washer, Tar Extractor, and Exhaust Regulator.

By E. G. Saville

In compliance with the request of the Committee of this Institution, I have pleasure in submitting a short paper on the above subject. To the present audience it would be presumption on my part to describe the use of a washer; but at the same time I think there are several appliances before the gas profession that are wrongly named—*i.e.*, those called scrubber washers. I maintain that a washer is an apparatus in which the gas is made to pass through liquor; and that a scrubber is one in which gas passes over wetted surfaces—a distinction with a difference.

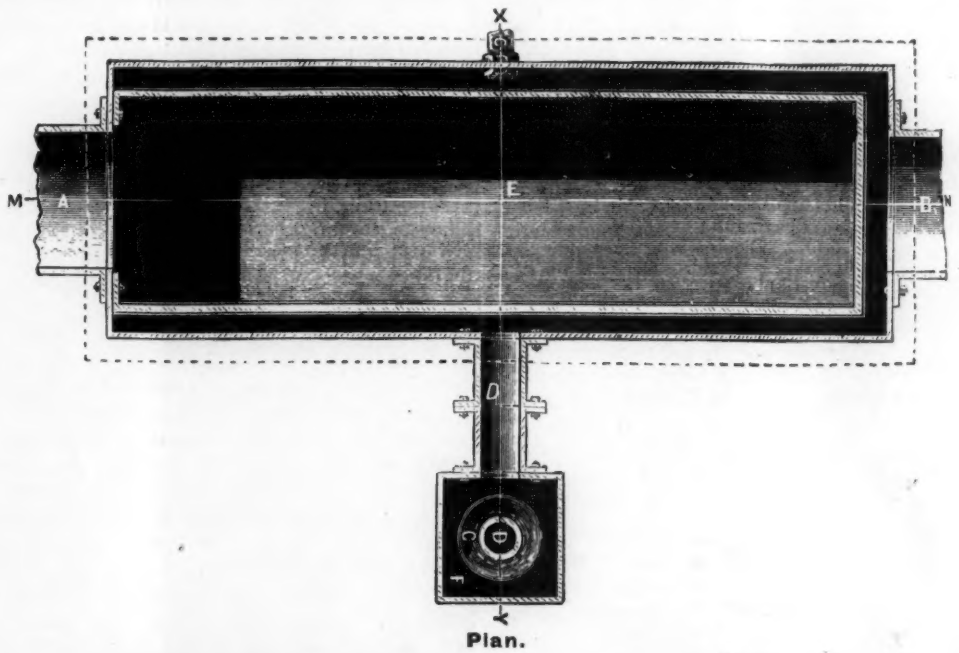
To proceed with my paper, the objects of the apparatus I am about to describe to you are to efficiently perform the work of an ordinary gas washer and tar extractor, and at the same time to prevent any undue exhaust or "pull" on the retorts by the exhauster; avoiding the ingress of atmospheric air or furnace gases, with their evil effects, which I am sure you all very well understand. The principle of it is copied from the ordinary gas pressure gauge; the gas acting on one side of the apparatus, and the atmosphere on the other side.

At the gas works where I am employed we have an old-fashioned exhauster, and I have had very great difficulty in efficiently governing its speed. I have always felt that all gas works ought to work without dips in the hydraulic main; but then again I have thought of the very many failures and difficulties that have occurred in this respect. I am disposed to think that the chief cause of the failures has arisen through not having the exhaust under proper control, not through any fault of the anti-dip.

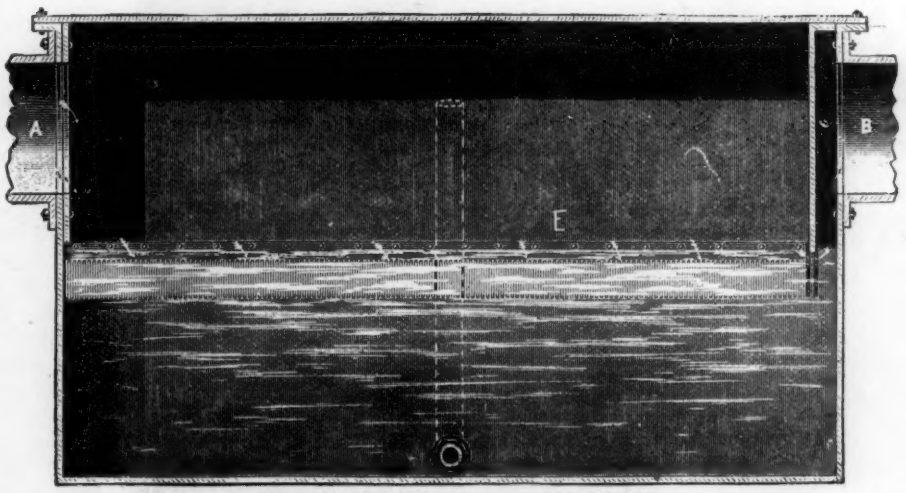
I was led to think of this arrangement of apparatus by noticing at our works on one occasion the variations on the gauge fixed on the inlet pipe of the exhauster, when a thought suddenly struck me that the very variation as shown on the gauge ought to be the means of adding to, or removing from, a seal or dip; that is to say, if the exhauster goes too fast it ought to increase the seal or dip either on the hydraulic main, or on some separate arrangement. The result of this idea has been that I have designed and fixed at the Todmorden gas works an apparatus of the type shown on the drawing now before you, which, so far as I know, is the first attempt to fix a washer before an exhauster. Since I adopted this arrangement I have been able, without any difficulty whatever, to work without dip on the hydraulic main, even with our old exhauster.

The different parts of the apparatus will be seen from the drawing (full size) now before you of an apparatus calculated to pass 15,000 cubic feet of gas per hour. *A* is the gas inlet, and *B* the outlet; *C* the inlet for liquor, and *D* the outlet; *E* is the washing compartment; *F* the overflow compartment; and *G* the movable overflow. In addition to the drawing I have pleasure in submitting a small model which will perhaps be better to understand than the drawing.

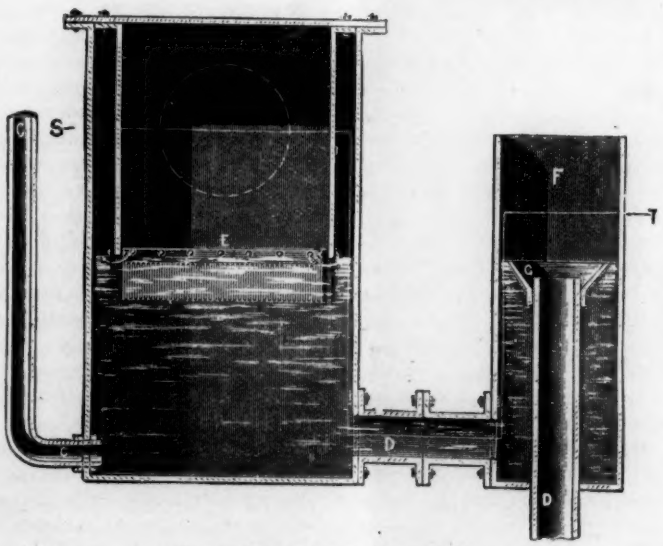
The apparatus should be fixed at a point on the mains between the



Plan.



Longitudinal Section on Line M N.



Cross Section on Line X Y.

outlet of the condenser and the inlet of the exhauster. To start it a constant stream of ammoniacal liquor (not necessarily a large quantity) is supplied through the inlet *C*; the gas is admitted at the inlet *A*, the movable overflow *G* being adjusted to the level which you desire to correspond with the pressure in the condenser. The gas then passes into the washing compartment *E* through the two rings of vertical slits shaped much like an ordinary comb. This particular shape breaks up the gas into minute globules, arresting any tarry matters, which readily slide down the teeth of the washing arrangement; immediately falling away from the gas through the pipe connecting the compartments *E* and *F*, and passing to the overflow *G*. No gas can possibly go through this apparatus without being thoroughly scoured with liquor. The method of rapidly passing the tar away as it is removed from the gas does away with the trouble of emptying the washer daily, as is the case with some washers. It will be found by experience that after about the first day the level originally adopted in the compartment *F* will not be correct, on account of the difference in the specific gravities of tar and ammoniacal liquor. The tar being in compartment *F*, and the liquor in compartment *E*, the movable overflow *G* has to be lowered to compensate for the difference in the two specific gravities. This difficulty may be avoided by filling the compartment *F* with tar in the first instance. I think that this may be accepted as proof that the tar is at once separated from and immediately leaves the gas.

Whatever error there may be in the ordinary working of the exhauster, the level of the liquid inside the washing compartment *E* will exactly rise or fall with the variations, and will be found to be as accurate as the pressure gauge itself. The amount of dip or seal of the washer can be set anywhere, from zero to 6 inches, by the draught of the exhauster. . The exhaust or pressure on the condenser and the hydraulic main can be exactly fixed by raising or lowering the movable overflow *G;* and if by any accident or neglect the exhauster runs below its speed, or entirely stops, the pressure in compartment *E* becomes greater than that in compartment *F*, and the seal is entirely removed—thus overcoming the difficulty complained of in other washers of throwing a great pressure on the retorts when the exhauster is standing still, as is often the case in small gas works during the summer months.

This arrangement of apparatus can be readily adapted where it is desired to work the air process for assisting in purification. By fixing a small valve on the outlet of the washer, and working the exhauster on the pull, any desired quantity of air can be admitted.

The advantages claimed for this apparatus are: (1) That it is an efficient washer; (2) that it is an efficient tar extractor; (3) that it can be fixed before the exhauster; (4) that it is a perfect exhaust regulator, guaranteeing a more regular quality of gas: (5) that the exhauster works with much cleaner gas, consequently causing less wear and tear; (6) work can be safely carried on without dips, thus producing a larger quantity of gas from the coals; (7) it is perfectly self-acting after being once adjusted; and (8) it does not require an expensive foundation, and occupies little space.

[Continued from Page 364.]

Notes on Gas Lighting and Gas Fitting.

By Mr. William Paul Gerhard, C. E.

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It would require more space than is at my disposal to describe and explain in detail the construction and working principles of the many kinds of burners invented and put on the market since the introduction of lighting gas into dwellings. Broadly speaking, we may distinguish 6 principal types of burners, viz.:

1. The single jet burner,
2. The fishtail burner,
3. The batswing burner,
4. The argand burner,
5. The regenerative burner, and
6. The incandescent burner.

The single jet burner is the simplest kind of burner, having only one small hole from which the gas issues. It is only suitable where a very small flame is required. The batswing or slit burner has a hemispherical tip with a narrow vertical slit from which the gas spreads out in a thin flat sheet, giving a wide and not very high flame, resembling in shape the wing of a bat (hence the name). The common kind of slit burners are not suitable for use with globes, as the flame is liable to crack the glass. The union-jet or fishtail burner consists of a flat tip slightly depressed or concave in the center, with two small holes drilled under a certain angle to each other. Two jets of equal size issue from these holes, and by impinging upon each other produce a flat flame, longer and narrower than the batswing, and not unlike the tail of a fish, wherefrom the burner derives its name. The gas consumption of the fishtail burners in cubic feet per hour is stamped on them, while on all slit burners the number of cubic feet of gas consumed per hour is indicated by the number of rings on the outside of the tip, each narrow ring indicating 1 cubic foot, while a broad ring stands for 4 cubic feet. But, inasmuch as the volume of gas consumed depends on the pressure of gas at the burners not less than upon the size of the opening or slit, this method is obviously unreliable. Both kinds of burners require no chimney, but the flames are usually encased with glass globes.

The argand burner consists essentially of a hollow ring of metal, connected with the gas tube and perforated on its upper surface with a series of fine holes from which the gas issues, forming a round flame. This burner requires the use of a glass chimney, properly proportioned in diameter and height, to induce perfect combustion by increasing the air supply to the flame.

The above are the principal burners more commonly used in domestic gas lighting. The argand as well as the batswing and fishtail burners have recently been much improved by Messrs. Sugg, Bronner, Bray and Silber, prominent English manufacturers of gas lighting apparatus. Further vast improvements in the shape of gas burners have been effected since the introduction of the incandescent electric light threatened to revolutionize domestic lighting. Not only have fishtail and batswing burners been much improved, but more recently burners constructed upon entirely new principles have been introduced, the regenerative and incandescent gas burners.

In all regenerative burners, such as those of Siemens, Grimston, Bower, Wenham, Lungren, Sugg and Bray, the high temperature due to the combustion in a gas flame is directly utilized to raise the temperature both of the gas before ignition and of the air before combustion, the result being an intensified combustion and a vastly increased illuminating power. These powerful burners are in successful use for lighting up streets and squares, stores and halls of audiences.

In the incandescent burners, finally, the heat of the flame is applied to raising to incandescence some foreign material, either a basket of magnesia (Lewis burner) or wires of platinum (Clamond lamp) or a funnel shaped asbestos wick, treated chemically with sulphate of zirconium (Welsbach incandescent light). The latter burner gives a particularly brilliant and white light when used in connection with water gas unmixed with naphtha gases.

Attempts have also been made in the so-called Albo-Carbon light to obtain a greater brilliancy and increased illuminating power by enriching ordinary coal gas with the vapors of naphthaline contained in a metal reservoir connected with the gas burner.

The brilliancy of all kinds of gas flames is reduced, as we have explained heretofore, when gas issues under too great a pressure, and also when the passages for gas, the pipes, the gas keys and the holes or slits in the burners become obstructed. An intense heat of combustion being favorable to increased luminosity of the flame, it is desirable that the latter should not be unduly cooled. The incandescence of the carbon is the more perfect the higher the temperature of the flame. Hence it follows that the burners or burner tips should not consist of a material which cools the flame. Metal tips for gas burners, and iron or brass burners are, on this account, inferior to burners or tips made of some non-conducting material, be this soapstone, steatite, lava, adamant or enamel. Metal tips are, furthermore, objectionable because they rapidly corrode and thus obstruct the free flow of gas at the burner, and this is a second reason why burners made of non-corrosive material should be preferred. Nickeled tips are said to be somewhat better than iron or brass tips, especially for water gas, but soapstone or steatite tips are undoubtedly superior. But even non-corrosive tips clog up in the course of time with incrustations of carbon, causing badly proportioned flames of irregular shape and leading to a waste of gas. Burner tips may and should be cleaned from time to time, but this should be done with care so as not to enlarge unduly the slits of the batswing or the holes of the fishtail burners. Occasional renewal of burners will often help to improve gas light illumination.

A good remedy for places where excessive gas pressure prevails consists in the use of pressure governors or regulators, placed on the main house pipe near the meter. Sometimes governors are combined with the gas burners in the shape of so-called governor burners, which will prevent the jumping or flaring up of flames on upper floors of high buildings (the gas pressure increasing with the numbers of stories) more effectually than any pressure governor at the meter. Both kinds of regulators prevent the waste of gas, give a more uniform and steady gas light and secure economy by reducing the gas bills, but they should not be used together, and in the case of high buildings the governor burners are preferable to pressure regulators.

The excessive heat caused by the combustion of gas and the resulting impurities contaminating the air, are often causes of annoyance, discomfort and occasional suffering. To remedy this several forms of ventilating gas lights have been proposed from time to time and introduced to a limited extent, such as the sunburner, the globe light and others. They are designed and constructed in such a manner as to remove at the ceiling the surplus heat and the incidental impurities of air due to gas illumination, by having outlets in the ceiling or over the gas flame connected with properly constructed vent flues in the walls. Some of the above mentioned regenerative gas burners are at the same time ventilating burners. All the various types of ventilating gas fixtures, whether chandeliers or side lights, are desirable from a sanitary point of view. In using them attention should be paid to the proper protection of woodwork in ceilings coming in contact with the tin branch vent flues, as the temperature of the escaping air may be quite high. It is desirable that the products of combustion be removed from near the level of the burners, which may be accomplished by arranging metal bells over the flame and connecting them with the vent flues. It is also necessary in order to accomplish good results, as regards ventilation, that the tin vent flues in the ceiling be made as large as possible.

Next to the burners the shape of the glass globes or shades surrounding the flame has much to do with proper illumination. The unsuitable arrangement of glass globes constitutes another factor contributing a share to the gas wasted by imperfect combustion. In order to obtain the maximum degree of light and also to avoid an unsteady and flickering light, the flow to the flame of the air necessary for combustion should be slow and regular, steady and uniform. Where the air supply is insufficient the flame is apt to smoke, blackening ceilings and contaminating the air. Where, on the other hand, a violent current of air rushes to and impinges upon the flame, the light flickers in an annoying manner, and the flame loses some of its heat and brilliancy by cooling. The old-fashioned styles of glass globes were made with very narrow openings at the bottom (often but 2 or 2½ inch diameter), and complaints of un-

steady light were common. Such globes with narrow bottom openings are objectionable, and should be entirely discarded, and globes with bottom orifices 4 inches or more in diameter should always be used.

All glass globes absorb more or less light, and hence cause a loss of illuminating power and a waste of gas. Experiments show that according to the thickness and opacity of shades the light is obstructed as follows:

By clear glass globes, from 10–15 per cent.
" slightly-ground globes, about 24 per cent.
" globes ground all over, from 25 to 40 per cent.
" opal glass globes, from 35–60 per cent.
" colored or painted globes, about 64 per cent.

It follows that clear glass globes are much to be preferred, and more economical, although where softness of light is particularly desired the use of opal globes is rendered necessary. The globe holders, too, should be as little light-obstructing as possible. An incidental advantage of glass globes of large bottom diameter is that a portion of the light falls directly into the room without being obstructed.

I must, in conclusion, offer a few remarks as regards the selection and the construction of proper gas fixtures. Many times poor illumination is caused by ill-contrived, poorly-constructed or defective chandeliers and bracket fixtures. Gas fixtures are, almost without exception, designed solely from an artistic point of view and without any regard to the proper conditions which alone enable us to obtain a maximum degree of light. Fixtures having an over-abundance of meaningless scrolls or spirals may, in the case of imperfectly purified gas or improperly run gas pipes, accumulate a large amount of tarry deposit which in time hardens and obstructs the passage for gas.

Another fault is the use of too small tubing for the gas fixtures. Having taken pains to pipe a house with adequate-sized pipes, it is equally necessary to have the passages for gas in the fixtures of ample bore; in other words, the main tube of the chandelier should be proportioned to the total number of lights which the chandelier carries, and the side tube for each light as well as the orifice of its gas key should be made ample in size to supply each burner with the requisite volume of gas.

A still more serious defect consists in the many leaky stopcocks of gas fixtures, caused either by defective workmanship or by keys becoming worn or loose. It is very rare indeed to find a house piped with gas where the pressure test could be successfully applied without first removing the fixtures. It is an almost universal experience that the joints of folding brackets, of extension or telescopic pendants and the keys leak much more than the system of piping, hence all chandeliers and bracket fixtures should always be proved and tested before being hung, and their keys made tight fitting. The mechanic who hangs the fixtures (usually not the gas fitter) should use particular care in making the joint where the fixture is attached perfectly tight.

Another point of importance to which the writer has frequently drawn attention in his practice as well as in his writings, is the use of old-fashioned gas fixtures with so-called "all-around" cocks; that is, cocks not provided with stop-pins. Such worthless fixtures are oftentimes the couse of gas leaks and become dangerous, particularly in hotels, apartment and lodging houses, when the gas key is incompletely closed, or by the accidental turning on of the gas after the key has been turned off and the light extinguished, causing frequent cases of death by inhalation during sleep of escaping coal gas, or of the much more fatal water gas. The use of cocks without check-pins or stops should, in my judgment, be prohibited by act of legislature. In fixtures of modern manufacture pin-stops are always provided; but here we often find another defect, the metal of which they consist being much too light and cracking or bending out of shape with repeated use. It cannot be too strongly insisted upon that all check-pins attached to gas keys should be of good size and made extra strong.

Water-slide chandeliers or water-joint pendants, which are extensively used in England and on the Continent, are another fruitful source of gas leaks, owing to the evaporation of the water in the joint. This can be avoided by frequent additions of water, or better still, by using a table-spoonful of sweet oil or glycerine which retards the evaporation of the water. Fortunately, such water joint pendants are not much used in the United States, being replaced by the much to be preferred extension joint chandelier with ground joints.

When we consider the many deaths caused by inhalation of illuminating gas and the injurious influence upon health of slight gas leaks, and of noxious compounds due to imperfect combustion of gas, it seems highly desirable that some kind of official and periodical supervision, similar to the one now exercised over the general construction of buildings, and over the plumbing and drainage in particular, should be carried out concerning the arrangement and quality of gas piping and gas fixtures in buildings occupied as residences or as offices. Until such official inspection will be secured it becomes the householder's duty to ascertain the tightness of gas pipes and pipe joints and soundness of fixtures and fixture keys. With advancing interest in this important and hitherto somewhat neglected subject, we shall hear in the future less complaints about vitiated air, destructive gas light fumes, immoderate heat, unsteady, flickering or poor light, blackening of ceilings and destruction of decorations, picture frames and book bindings.

The Education of an Engineer.

The following excellent article on the above subject is taken from *Engineering:*

The young man who desires to learn all that an engineer should know has to make up his mind to work very hard for several years. He has, in fact, to serve two apprenticeships at the same time, and he cannot afford to neglect either. He must acquire experience in the workshop, or upon large undertakings such as docks, railways, or canals, and he must also obtain a thorough grasp of the principles of engineering science, together with sufficient mathematical knowledge to turn the principles to account. Now either of these objects may be easily made to cover three or four years, and yet they have usually to be both crowded into the period between the ages of 16 or 17 and 21. Formerly the two sets of studies had to proceed concurrently; the day was spent in the works or the drawing office, and the evening was devoted to books, sometimes with such assistance as could be obtained from educational institutes that opened their doors after dark, but still oftener alone. Nearly all the successful engineers of the present day followed this plan, and it cannot be denied that it produced fine men. It taught them to "endure hardness," to investigate for themselves, and even if they fell short of learning a great deal that would have been of use to them, the attempt to learn under difficulties often was of more service, by developing their characters, than the knowledge that they lost would have done. In spite of the improvement of our educational system, and the establishment of high-class technical colleges, this system of evening study must be the portal through which the great bulk of engineers will enter the profession. There is a disposition now to hold it up as an impossibility to study at night after doing a day's work. But the day is not only shorter but easier than it used to be. The old hard work of chipping and filing, which brought the perspiration out of every pore, and made all the muscles ache, has nearly disappeared; in place of it the fitter spends a great deal of his time marking his work out for the machines, and when it is returned he has little to do beyond assembling the pieces. At five o'clock, in most places the day is over, and a movement is on foot to end the week at noon on Saturday. In a provincial town, where the distances are not great, the apprentice has reached home, washed, dressed, and eaten his meal by six o'clock. He can then easily give two or three hours to study four or five nights a week between October and May without unduly taxing his constitution. For it must be remembered he does not come home brain-weary; he feels some bodily fatigue, no doubt, but his mind is not worn. In this respect he is in quite a different position from the clerk who has been bending over a desk adding up columns of figures. The latter is really jaded, and may readily excuse himself if he fills up his winter evenings with a pipe and novel. Unless the youthful engineer follows some consecutive study, there is great danger of his mind not only losing what it has acquired, but also of becoming sterile as well, so that the habit of learning cannot be regained to its fullest extent. An extended acquaintance with engineering premium apprentices shows us that many of them contrive to throw overboard while in the shop a good part of what they learned at school, and at the end of their term they are poorer in intellect and morals than when they commenced. How can it be otherwise unless they are encouraged to exercise their minds as well as their bodies? Fifty-four hours a week spent in workshop society needs some corrective, especially in the case of youths living in lodgings. If part of the remainder of the time is not occupied with books, it is very apt to be devoted to music halls and the consumption of bad whiskey. We enter our protest most emphatically against the doctrine that after a day's work it is impossible to study. Of course there are exceptional cases, but they should be met by cutting off the working hours before breakfast, and not by giving up the evenings to idleness. If a growing youth shows signs of a physical strain, let him have the extra two hours in bed in a morning. When the body is weary and the spirits flag from exhaustion, the mind becomes susceptible to every temptation. The evening hours will be filled with something, and at this time, if the youth is moved from the surroundings of a refined home, his safest resource is study.

Evening study has another value; it forms a gauge to mental habit and

capacity. There is to-day a great tendency to over-education. Examinations set one standard, and everybody is expected to aim at that. Parents are told that a full knowledge of engineering science cannot be obtained without a course of technical instruction, and forthwith they all send their boys to college. Now, there may be circumstances in which this is the correct course to follow. For instance, in France, where the greater part of engineering is done by officials, and where there is no redundant population to provide for, it may be advisable to bring all boys up on a regulation system. Each will have to occupy a post formerly filled by a man similarly trained, and will have to form part of a department in which idiosyncrasies are inconvenient. But in this country affairs are very different. If the rising generation of engineers are to live, many of them will have to go abroad and settle there. It is only an infinitesimal percentage that can look forward to becoming lights in Great George street, and those who expect it most confidently are least likely to get there. Now the boy who will eventually become the average colonial engineer may spend his time more profitably than by going to college. If a youth has no taste for learning, if he did not do fairly well during the last two years at school, and if he make no progress in the evenings of his apprenticeship, it is pretty certain that his intellect is not capable of going deeply into theoretical considerations. He may have the elements of success in him, energy, self-reliance, and the power of commanding men, and yet be a very poor learner from books and lectures. Or he may just be a mediocre man, industrious and patient, but nothing more. In either case, it is foolish for him to follow the fashion of sitting at the feet of professors. The energetic self-reliant man can always hire the student to work for him at so many shillings, or pounds, a week, charging ten times as much for his assistance as he pays for it. Recently a leading engineer, speaking to us of a work he had finished, said, "I employed Mr. So-and-So, who is a very clever mathematician, to work out the strains." Yet Mr. So-and-So was never heard of by the public, although the work in question is well known. As for the mediocre man, he will probably never rise into a position in which he will have the opportunity of applying any high mathematical knowledge. But, nevertheless, he may do very good work in the world, and make an excellent living if he be trained in the proper direction, and not be forced to follow the fashionable course. The secret of success is to find out one's natural bent and to follow it. If that only can be done, failure is scarcely possible. The man who can do something better than all the rest of the world will make a fortune. It scarcely matters what it is, whether it be pleading before a jury, writing a prescription, walking a tightrope, or grinning through a horse collar, money flows freely to the best man.

Now, among the engineering apprentices there are plenty capable of forming excellent mechanics of some kind or other, if they are only trained. The colonies are badly in want of such men, and offer them good fields. It is well known that the standard of handicraft proficiency is declining among workmen, and that the all-round man, who can tackle any job that comes into a country smithy, is growing daily scarcer. Yet how much happier would many a boy be if he received a thorough handicraft training and were sent to the colonies with the promise of 500*l.* to start business with in a few years, than if the same had been spent in college fees, and he were left to pass his life in ill-paid labor, which he had learnt to despise. Parents have an unfortunate habit of thinking that their ugly ducklings are all swans, which much interferes with the proper selection of callings for them. But they may feel assured that if the boys they are bringing up as engineers exhibit no taste for theoretical knowledge it is useless to have it crammed into them at college. If a youth in an engine builder's shop never cares to learn something of the properties of steam, if he never investigates the action of different types of valve gear, if he carries a slide rule that he cannot do a single calculation with, then the indications are not sufficiently promising to warrant his undergoing the regular course of technical instruction, that is, if he has to make his own way in the world. Even if he exhibit a laudable desire for knowledge, but falls short in the attainment of it, it will probably be better to direct his energies into a channel for which they are better fitted.

The question is continually debated whether the training in the shops should precede or follow the college course. If we ask the opinion of a works manager he says that the youths he gets from college are fearful prigs and do no good; they imagine they know everything, and despise all the work they are expected to do. The professor, on the contrary, says that the shop-trained lad is conceited beyond endurance; he regards the refinements of knowledge as foolishness, and has no patience for delicate investigations that do not promise some immediate practical result. It is the old case of Sandford and Merton over again. The former youth, surveying a party of finely dressed ladies, wondered what they would do if they were cast on a desert island. Similarly the practical boy contemptuously asks what kind of a figure the professor and his class would cut if sent out as a break-down gang on a railway. Tommy Merton declined to give his attention to mechanic arts, and in like manner the collegian cannot imagine that he can learn anything by cleaning out a boiler. We fear those difficulties are irremediable, and will always have to be met. But we are strongly of opinion that there is less difficulty if the shop training comes first As we have already said, it gives an opportunity of deciding whether there should be any college training at all. That, of itself, is sufficient to cast the balance in favor of this plan. Then, again, it enables the right order of study to be followed; first school, then evening instruction aided by second-rate teachers, and lastly training by eminent professors. If the college follows the school the immature mind will not be able to take full advantage of it. Then during the after period of apprenticeship the youth will generally be too advanced for the teachers of evening classes to give him much assistance, and he will thus be left entirely to his own resources.

A still more cogent argument against college preceding the shop is found in the contempt for manual labor which comes to the student. After a boy has been engaged in research, and has learnt how to make fine measurements, and how to work out his results with extreme accuracy, he thinks he has nothing to learn from rough workshop practice. The dirt repels him; but more particularly he is dissatisfied with the inconclusiveness of his observations. He has been accustomed to arrive at some definite result with a small margin for experimental errors. But in the shop he cannot codify his knowledge. He sees a certain phenomenon to-day of a kind which cannot be expressed in figures, scarcely in words. It may be months before he finds another example with which to make a comparison, and in the meantime the recollection of the first has grown so dim that much of its value is wasted. Again, in the laboratory he generally knew what to look for, and could reject everything else. But now most that happens around him is on the same level, and there is nothing to focus his attention. He feels that he is not acquiring anything. Day after day passes and he cannot see that he has added to his store of knowledge; he has only progressed one step towards becoming more like a workman, an end that has no interest for him. He does not realize that the conditions of daily life are never those of the laboratory; the problems set him have not hitherto had any factors which can be estimated only by judgment and experience, and he does not know that in his professional career six-sevenths of his work must be done by a kind of unconscious knowledge which resembles instinct, He is, in fact, learning something of which his previous training has rendered him incapable of estimating the value.

We fully admit that the shop-bred boy has also difficulties to face before he can bring himself to appreciate the minutiæ of the laboratory. But if he has carried his scientific education as far as he ought to have done, he has learned that he is very ignorant of much that he ought to know, if he is to attain a high rank in the profession. In every science he has studied he has found himself stopped by his want of knowledge in some other science. He has asked questions in the works which nobody there could answer, and has longed to make experiments for which he had no apparatus. Consequently the laboratory opens up to him fresh opportunities, and whatever contempt he may, in his juvenile conceit, feel for some of its methods, he must know that there is a great deal to be learned in it.

No one will imagine, we are sure, that we are disposed to decry the value of a well-directed course of college training. What we object to is that it should be administered to all sorts of youths, like the old brimstone and treacle. We are told that an engineer can never know too much, and there is such a vast mass of knowledge that he may turn to account that he must have it prepared and partly digested if he is to acquire it in a moderate space of time. This is, no doubt, true, but it needs a powerful intellect to wield such an armory. And if it is not utilized it is only a drag on its possessor. It is a beautiful idea to pursue knowledge for her own sake, but it does not always add to our happiness. The technical student who finds that he has not the knack of applying his theories, and who is passed in the race by men who have not one quarter his acquired knowledge, feels that he is, in some way, unjustly used. He has given time, money, and labor, and in return he gets only a heightened sense of his own inferiority. Or he may so lack that magnetic quality which inspires confidence that he never gets the chance of applying his knowledge. In either case he had far better have spent the time in learning a useful trade, as, for instance, that of a smith or mechanic, which he could have carried out with credit to himself and benefit to the community.

Given an engineer of strong intellect and self-reliant disposition, a thorough technical training is the richest possession he can acquire.

The ball is then at his feet; he can watch the turn of events, and take advantage of every opening. Science is to him a wand by which he can command the great powers of Nature, and bend them to his use. Further it is a means of education which strengthens his brain, just as exercise invigorates his body. It renders every sense alert, quickens his perception, and furnishes him with a hundred clues by which he can advance when he has reached the end of the trodden paths of knowledge. Without it he is in a more or less dependent position; he may command the knowledge of others, but this is a very different thing from having it himself. He has not only the consciousness that he gains an amount of credit which is not his just due, but his power of initiation is shackled. He has to proceed by faith to a certain extent, and possibly his faith may be misplaced. It by no means follows that he cannot attain a high position—a vigorous intellect will insure him that—but he cannot reach the top rung of the ladder. A man of equal natural parts, but better trained, will surpass him.

In a recent article we dealt with the education of boys intended for the engineering profession. We laid it down that before the age of 14 there should be no attempt to specialise their knowledge, and very little to acquire knowledge at all. The time should be spent in teaching them how to see, how to feel, and how to learn. From 14 to 16 or 17, we recommended a course of science and mathematics, tempered by modern languages, history, poetry, and fiction. That brought us to the period of apprenticeship of which we are now writing. That, as we have set forth, is the term during which the parents should exercise the greatest vigilance and discrimination. The natural idiosyncrasy of his son, freed from the petty restraints of school, begins to show itself, and it is possible to forecast his character. His career ought to be moulded according to his ability, for it is only under this condition that he may be expected to develop under the most favorable circumstances. But if he be merely sent through the regulation mill, and crammed with the prescribed array of facts and theories, he is, in fact, left to chance as completely, although in a different way, as the lad that is allowed to grow up in the gutter. There is no system applicable to all intended engineers, any more than there is a medicine suitable for all complaints; the man who avers either the one or the other is a quack. Just as the physical system needs more discriminating medical treatment as it grows older, so the mental development requires to be more narrowly watched as it proceeds. An ailing child generally gets a dose of the current household remedy—senna, or magnesia, or what not—and usually is the better for it. But as we grow older we abandon this rough-and-ready system of medication, and submit our system to the inspection of experts, who not only choose the drugs but narrowly watch their actions. The mental treatment of youths deserves equal care, and when it is found to be unsuitable it should be promptly changed. The past generation suffered from want of instruction, but that which is now rising is likely to have too much. They ought to have just as much as they can assimilate, and no more.

Specifications for Cast Iron, Coated Water Pipe.*

By Mr. T. W. Yardley, Chicago.

In many years experience as a maker and purchaser of cast iron coated pipe, I have never met with any standard form of specifications for such. Each water works company employing a hydraulic engineer has, under his direction, prepared complete specifications for the particular conditions required. I therefore have the honor of offering to the Institute a form of specifications for cast iron coated water pipe that will be found useful to water works companies and others requiring pipe of this kind. The conditions are all reasonable, and can be carried out by makers without additional cost, and with advantage to purchaser.

Section 1 gives the kind of pipe, with its general characteristics.

Sec. 2 specifies that neutral pig iron shall be used, since such iron possesses the strength required and is uniform in shrinkage.

Sec. 5, requiring makers to give the brand of pig iron used in the cupola, is intended to guard against the use of cinder iron. The characteristics of the ores used in blast furnaces give to each its reputation, and the furnaces using cinder are all well known.

Sec. 7, providing that the shell of each pipe shall be measured for thickness throughout its entire length, enables the inspector to determine whether there are thin plates near the middle of the pipe, where such imperfections are most likely to occur. An inexpensive instrument adapted to such measurement has been devised.

Sec. 8 provides for a test bar, from which to determine the transverse strength of the iron. This bar is convenient in form, can be made with very little cost to the maker, and will give the most satisfactory test of the strength of the iron under the conditions to which the pipe will be subjected in service.

Sec. 11, requiring that all pipe shall be stripped immediately, if taken from the pit before cooling, is very important, for the reason that when pipe is taken from the pit hot a deposit of loam is frequently left in spots on the outside, and wherever this occurs the cooling is irregular and the shrinking strains are unequal. The weakness thus produced may not show under the subsequent hydraulic test, but may be developed after the pipe has been subjected to rough treatment in railroad and other transportation into the trenches.

Specifications for Cast Iron Coated Water Pipe.

Sec. 1. The pipe shall be of the usual kind known as "hub and spigot;" each pipe shall be 12 feet in length from the bottom of the hub to the end of the spigot; the form and dimensions of hub and spigot ends shall be as marked on and shown by drawings, to be furnished or approved by purchaser.

Sec. 2. The metal shall be of the best quality for the purpose, made from what is commercially known as "neutral" pig iron, which shall have been made from iron ores without the admixture of cinder, and when cast into pipe the metal shall be tough, and of such density and texture as will permit its being easily cut and drilled by hand.

Sec. 3. Each pipe shall have cast on the exterior surface of hub * * * in raised Roman letters, 1½ inches long, and shall be further marked in like manner with letters and figures to designate the maker of the pipe, and the year; also serial numbers shall be cast on each pipe, commencing with a number to be designated by the purchaser.

Sec. 4. The pipe shall be cast in dry sand molds or flasks, placed vertically, and shall be of the several diameters named in the contract. The shell shall be of uniform thickness of metal, smooth and sound, without cold shuts, lumps, swells, scales, blisters, sand-holes, or other imperfections; truly cylindrical, of full diameters, and with interior and exterior surfaces concentric.

Sec. 5. Chemical analysis of the iron used shall be given whenever asked for, and a written daily report shall be furnished to the inspector, giving the brands of pig iron used in each day's melting.

Sec. 6. Each ladle of iron from which the pipes are poured shall be designated by a consecutive number, beginning with each day's work. A daily record of pipes cast shall be kept and furnished to the inspector, and must record the number of the ladle from which each pipe was poured, as well as the number on the pipe.

Sec. 7. The shell shall be of uniform thickness throughout its entire length. Should the inspector find in any one place a variation in thickness of more than 10 per cent. less than that specified in the contract, such pipe shall be rejected.

Sec. 8. From each ladle of melted iron there shall be cast one test bar not less than 26 inches long, 2 inches wide and 1 inch thick. This bar shall be tested for transverse strength when loaded in the center, 24 inches between supports (narrow sides vertical), and shall carry a center breaking load of not less than 2,000 pounds, and show a deflection of not less than $\frac{3}{10}$-inch before breaking. This bar shall be cast as near as possible to the specified dimensions without finishing up; but correction shall be made for variation of width and thickness, and the corrected result must conform to the above requirements.

Sec. 9. If any test bar shows a breaking strain or deflection less than the above requirements, all pipe made from the corresponding iron shall be rejected.

Sec. 10. The maker shall furnish to the inspector in charge two wrought iron rings (male and female templates), the one showing the outside diameter of the spigot end and the other the inside diameter of the hub end of each size of pipe, and the said pipe shall conform in diameters to the respective templates.

Sec. 11. The pipe shall be thoroughly cleaned, both inside and outside, without the use of acid or other liquid. If the pipe is stripped while above a dark blue heat all sand must be removed from the outside immediately.

Sec. 12. When the pipe is so cleaned it shall be heated to 300° F., and immersed in a bath of coal pitch varnish of an equal temperature. When the pipe is removed from the bath this coating shall fume freely, and set perfectly hard within one hour from the time of removal. No pipe shall be tested by hydrostatic pressure until the varnish has become hard.

Sec. 13. When coated the pipe shall be subjected to a test by hydrostatic pressure of not less than 450 pounds per square inch for 6-inch and 8 inch; 400 pounds for 10-inch and 12-inch, 350 pounds for 16-inch and 20-inch; 300 pounds for 24 inch and 30-inch; and 250 pounds for all 36-inch diameter and upward; and while under pressure the pipe shall be subjected to an additional test by a series of smart blows at

*Am. Institute of Mining Engineers.

various points throughout its entire length with a 3-pound hammer, attached to a handle 16 inches long. If any failure is shown in the pipe during this test it shall be rejected.

Sec. 14. The weight of each pipe must correspond as nearly as possible to the standard named. Any pipe which may fall short over 5 per cent. of the standard weight shall be rejected, and no weight shall be allowed or paid for any pipe that shall exceed 2 per cent. of the standard weight. These requirements shall be determined by the weight of each pipe separately.

Sec. 15. All special castings, such as "Ell's," "Tee's," "Y's," bends, crosses, etc., shall be made from the same mixture of pig iron as has been approved for pipe; and all such castings shall be submitted to the same care in cleaning and heating, and the bath shall be used under the same conditions as for straight pipe.

Sec. 16. All appliances necessary for the inspector to carry out the requirements of these specifications shall be furnished by the maker free of cost to the purchaser.

Discussion.

J. C. Bayles, East Orange, N. J. (communication to the secretary)—As a purchaser or user of cast iron pipe or any other kind of pipe, I should not be satisfied with so much of Mr. Yardley's specifications as relates to coating and testing. I should in every case demand that the pipe be tested before it is coated. This is especially true of cast iron. Any form of coating suitable for a pipe which is to be shipped and handled will conceal a multitude of small defects in casting, such as blow holes, sand holes and even small shrinkage cracks. In 1887 the Commissioners of the Health Department of New York City found it necessary in the discharge of their responsibilities relative to the plumbing of new buildings, to amend the plumbing code by the insertion of a clause forbidding the use of dipped, varnished or painted pipes. The reason for this action was the discovery that even a thin coating, of very little value as a protection for the iron, could be made to conceal so many foundry defects, and permitted so much carelessness on the part of makers, that sound pipes were the exception rather than the rule. The value of such a coating in enabling pipes to pass a test is shown in much of the light riveted pipe in the market. I have seen a pipe put together with small, cold rivets, headed by pressure, which, after coating with coal tar and asphalt, has shown in the testing machine a capacity to carry without leaks a test pressure much higher than Mr. Yardley prescribes for the strongest and heaviest cast iron pipes he mentions. Before coating the seam would have shown a continuous leak from end to end. The fact that a coated pipe will hold water under a considerable pressure in the testing machine seems to me to speak more for the coating than for the pipe. A cork inserted in the end of a gun barrel will usually be found in place when the explosion of the charge has burst the barrel. Experiments show that a plug of mud, or even of snow, will do the same. As a manufacturer of pipes, I should be very much pleased to have consumers specify that none should be tested until they had been coated. We should have very few wasted. For cast iron pipes the test pressures prescribed by Mr. Yardley seem to me much higher than is necessary. The caulked joint is not adapted for high pressures, and cast iron pipe is seldom employed under pressure greater than a lead caulking will stand. It is not unusual in water works practice for the lead to blow out of pipe joints at pressures much below those which the pipe will carry safely and comfortably. This is especially true if opportunity is offered for such changes of temperature as will produce a measurable contraction and expansion with the changes of the seasons. The strength of the pipe cannot be greater than the strength of its joints, and with the hub and spigot connection the usefulness of cast iron pipes as a pressure conduit has well defined limitations. In buying it for any purpose for which that kind of pipe is adapted I should be content with half the test pressures prescribed by Mr. Yardley, but should insist on having the test made before the pipe was dipped—and, for that matter, I should require a very much better coating, after testing, than a coal pitch varnish applied at 300° F.

Mr. Yardley (communication to the secretary)—Cast iron pipes for water works were first used by the New River Water Works Company, of London, England, in the year 1810. In 1822 the greatly increased demand for water made it necessary for the company to enlarge the mains. In taking up some of the pipe laid in 1810, many were found rusted so much that they were unfit for future use. This fact coming to the notice of Dr. Angus Smith, he commenced a series of experiments in the preparation of a coating of varnish to be applied to the inner and outer surfaces of pipe to be used for carrying water. His experiments demonstrated the fact that his varnish would not stop the rust when it had once commenced, notwithstanding the rust was covered by the varnish. It was then he adopted the system of coating pipe as soon after cleaning as was practicable, and requiring the pipe to be heated to 300° F. before immersing it in the bath.

In 1858, some of the pipe being taken from the trenches in which they had been underground for 30 years, the varnish was found hard and bright, and the pipes that were broken gave no sign of rust. So satisfactory was this result that the English Government gave a patent therefor to Dr. Angus Smith, and his process has since been used by all makers of cast iron pipe for water works. In making my specifications I have followed what I believe to be the recognized practice of the best hydraulic engineers of this country, and I know I have the endorsement of many. I was not aware until Mr. Bayles made the statement that tar coating possessed so much strength. If he is correct, would it not be more economical for water works companies to have the iron shell of the pipe much thinner than now used and give the pipe greater thickness of tar? In regard to the hydraulic test, I have the best authority for the pressure required for all pipe above 16 inches diameter. The increased pressure is specified for the smaller diameters, because the water test is the only one used. It would be very inconvenient, as well as quite expensive, for the makers if they were required to take test bars for so great a number of pipes as the foundry could turn out daily of the smaller size.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Mr. Bartlett S. Johnson (of Baltimore) President of the Greensboro (N. C.) Gas and Electric Light Company, has just returned to his home after a protracted stay in Greensboro. He is enthusiastic over the prospects of the Company, and quite confident as to the growth of Greensboro as a business center. He is also authority for the statement that many indications of a deposit of petroleum have been found on the farm of a Mr. J. J. Phœnix, whose place is but one mile distant from Greensboro. This would mean great things for the town.

The Alton (Ills.) Novelty Company is under contract to construct a gas plant at the Monticello Seminary, Godfrey, Ills.—this place is about three miles from Alton—the iron work, etc., to be furnished by a St. Louis firm, whose names we are not able to give. The plant is to comprise two benches of threes, and a holder with a capacity of 20,000 cubic feet. Miss Haskell, the Directress of the Seminary, had under consideration the installation of a small water gas plant, but finally decided in favor of the coal gas equipment.

The works at Tallapoosa, Georgia, have been leased by Mr. A. E. Fenkell, of Atlanta, Ga.

For the following probable programme of the outing at the Savannah convention of the American Gas Light Association we are indebted to a correspondent, who obtained the account from Mr. David Douglas, President of the Mutual Gas Light Company, of Savannah. Mr. Douglas said: "The Mutual Company is determined to do its part in making the occasion a success, especially as it is reasonably certain that many ladies will accompany the delegates. It is likely that the convention will be formally welcomed by the Mayor, Aldermen and other city officials on the morning of October 15, in the banquet room at the De Soto. Meanwhile a committee of Savannah ladies will extend a welcome to the visiting ladies of the Association, in the hotel parlors. These formalities having been disposed of, the Association will proceed to business, which will include the reading and discussion of papers, etc. Carriages being at the doors, the ladies will be driven to places of interest throughout the city. On the afternoon of the same day the ladies will hold a reception in the parlors to all members of the Association, and to their friends in Savannah. At this reception introductions will be made and acquaintanceships formed. After the regular hotel dinner, theatre boxes having been previously engaged, parties will go there, while possibly others will visit some of our Savannah homes. Cobb's band, and perhaps some of our colored minstrels, will entertain such in the rotunda of the hotel who do not care to go out. On the second day, a drive by the ladies and their friends to Bonaventure and Thunderbolt is contemplated, and on the return a ladies lunch will be provided. On the evening of this day the Mutual Gas Light Company will entertain all the members of the Association at a magnificent banquet in the dining room of the De Soto, which is expected to be the grandest affair of the kind yet given in Savannah. A guarantee of at least 275 guests has been made to Messrs. Watson & Powers, but 300 or more are expected to be present. The lessees of the De Soto are under contract to furnish as fine a dinner as can be given in the United States, and there is no doubt but that they will fill the contract. The banquet hall will be handsomely decorated with palms and other tropical and sub-tropical plants and flowers, and the

tables laid and furnished with everything that art and fancy combined can suggest to make them beautiful. Music will be furnished by Cobb's orchestra, the Magnolia quartette, and by the best vocalists of the city. Handsome bouquets for each guest will be at every plate. The menu cards, especially designed and engraved, are expected to be something unique. A considerable number of Savannah's prominent citizens will be invited to the banquet, and some of Savannah's gifted orators will be down for speeches on the toast list. On the third day of the meeting it is proposed to have an excursion down the river, the party first visiting the Ocean Steamship Company's wharves and going over such vessels as may be in port, thence the excursionists will be conveyed by steamer slowly along the harbor, visiting the immense new cotton compresses of the Savannah Tyler Cotton Press Association, thence down the river to Tybee and return. Souvenirs made of cotton in the boll, rice in the ear, and Southern grasses tied with ribbons, appropriately printed, will be given by the ladies to each guest. The United Gas Improvement Company, of Philadelphia, is preparing an equally pleasing and suitable souvenir for gentlemen. During the meeting there will be exhibited many new and interesting devices in the gas business perfected during the past year. The Mutual Gas Light Company intends to make a special display of its new fuel gas and the Welsbach burner, lighting up especially for the occasion the meeting rooms of the Association, and also the main dining hall of the De Soto."

THE use of gas for lighting purposes in San Francisco, Cal., dates from the formation (August 31, 1852) of the San Francisco Gas Light Company, with Mr. Beverly C. Saunders as President, and Mr. John Crane as Secretary. In 1856 James Donahue was chosen President, J. Mora Moss, Vice-President, and Joseph G. Eastland, Secretary. On August 17, 1862, James Donahue died, in 1863, J. Mora Moss was elected President, and Peter Donahue was made Vice-President. In 1865 Peter Donahue was elected President, serving as such until 1883, when he was succeeded by E. P. Murphy. In 1873 the San Francisco Gas Company united with the City Gas Company, and reincorporated under the present title. The affairs and practical management of the Company were in the hands of Mr. James G. Eastland, who controlled the one and directed the other with consummate skill and tact until his resignation was reluctantly accepted. He was followed by the present Secretary, Mr. Wm. G. Barrett, who has been in the Company's service in one capacity or another since 1868. In 1885 Mr. Murphy retired from the Company, whereupon Mr. J. B. Crockett was named as his successor. Mr. Crockett, whose reputation as a gas engineer is a national one, first took service with the Company in 1869, and beyond a doubt he is the right man in the right place. The works have kept pace with the developments in the business, and, as stated in the JOURNAL some weeks ago, a magnificent new station is shortly to take the place of the old or central plant, thus adding a fit companion to the station not so long ago completed in the Potrero District. It is instructive to note that at one time in the Company's history gas was sold at $15 per 1,000, whereas now it is disposed of at $2.

THAT 'Frisco is a good gas town is further borne out by the fact that the Pacific Gas Improvement Company's plant, which is located at North Beach, between Bay and Francisco, and Fillmore and Pierce streets, has a capacity of 1½ millions cubic feet per day, has 80 miles of street mains, and employs a force of 100 men. Its officers are: President, Alfred Miller; Vice President, G. W. Beaver; Secretary, J. M. Livingston; Treasurer, C. O. G. Miller. Its affairs are well managed.

MR. J. F. B. JACKSON, as President of the Birmingham (Ala.) Gas Company, has submitted the following proposals to the authorities, respecting the public lighting, etc., the agreement to last for ten years: Gas lamp posts, all night, 4-feet burners, $1.25 each per month; gas consumed by churches, and in the public buildings, $1 per 1,000; to private consumers, not to exceed $1.48, net; a special rate to be made for gas used for heating purposes. The proposals were referred to the Committee of Council on Gas and Electric Lights.

THE proprietors of the Port Henry (N. Y.) Gas Company announce that on and after October 1st the gas rate will be reduced to $2.25 per 1,000 cubic feet.

AT the annual meeting of the Concord (N. H.) Gas and Electric Light Company the former Directors were re-elected, and the Board organized by naming the following officers: President, Hon. John Kimball; Clerk, Hon. Sylvester Dana; Treasurer, Hon. E. H. Woodman.

WE understand that Mr. W. T. Coad, who holds the franchise for a Gas Company at Rapid City, So. Dakota (under the terms of the concession construction work must be commenced 30 days after the signing of the grant), has agreed with Chicago contractors as to details of plant, etc. The works will cost $65,000; so it is said.

MAURICE BIDELMAN and ex-Mayor R. A. Bury, of Adrian, Mich., have gone into, or will go into (perhaps) the business of gas making at Adrian. We are gravely told, by a local newsman, that Bidelman has, for some 12 or 15 years, been experimenting in gas making on an "improved plan," and his efforts have at last been "crowned with success." Of course, gentlemen, the same old crown, the weight of which has crushed out so many hopes. Our informant, in describing the improved Bidelman apparatus and system, says of it: "Finally, in 1887, his new machine was perfected, and the first patent was issued in February, 1888. He had discarded the old method of tin reservoirs, and the new invention consists of a series of generators, each made of boiler iron and holding 100 gallons"—of what will be disclosed later on. Taking up the thread again: "These are filled with charcoal, and into each are placed 10 gallons of oil. Instead of using the crude petroleum, the product known as crude distillate is the article now exclusively used. It was found that the crude oil left a large residuum, which could not be utilized, and was a source of considerable trouble. The crude distillate is the oil with the solids refined out, and though more volatile than benzine, it leaves comparatively no residuum, though an allowance of 15 per cent. is made therefor in estimating the cost of the gas product. Not less than 4 generators can be used, and this would answer only for a small plant. A set of 9 generators, standing side by side, connected by a 2 inch iron pipe, will produce 5,000 feet of gas in an hour, and by doubling the number and speeding the engine, the same connections would produce 10,000 feet. The air is forced into the first generator through the pipe, which goes nearly to the bottom of the generator, and rising through the oil, the air enters the next generator, each generator being piped alike. The rapid passage of the air through the oil forms a chemical change by aid of the charcoal, and a part of the oil is taken up from each generator, the quantity growing less and less, until the last generator is used. A glass gauge attached to each generator shows the amount of oil in store. The amount of oil used is 2 gallons for each 1,000 feet of gas. The oil costs not to exceed 4 cents a gallon, delivered. Here we have the net cost of material, 8 cents for 1,000 feet of gas. The gas furnishes a cheap fuel for its steam power, and a 12-horse power engine can easily pump the air necessary to produce 10,000 feet of gas per hour. The quality of the gas is far superior to ordinary coal gas, having, without doubt, three times the illuminating power, and more than double the heating capacity." There is much more "descriptive matter" of a like sort respecting the Bidelman process; but we imagine that enough of it has already been given to mystify our readers as completely as we are mystified ourselves over its windings. We can, however, completely understand our correspondent's closing intimation that a Company has been formed for the purpose of manufacturing the machines, and also for disposing of territorial rights, etc., even though we fail to believe with him that the "Company is in possession, without doubt, of the most valuable patent in the United States." To go a step further, we would calmly advise him to step over to the works of the local Adrian Gas Light Company, at which place Superintendent Raynor will no doubt be glad to show him how gas should be made—even if it does cost a trifle over 4 cents per 1,000 cubic feet. In our present light on the subject, we fail to see how we can come to any other conclusion than to catalogue the Bidelman process in the list of gas abortions that are seemingly of ceaseless recurrence.

THE Manufacturing Investment Company, of New York, has placed its contract for a new mill, at Madison, Me., which is in the center of what is known as the wood pulp district, with the Berlin Iron Bridge Company, of East Berlin, Conn. The buildings, which are to be of iron, from the designs of the Iron Bridge Company, will comprise a "digester" house, 62 feet wide by 220 long, and four stories high; a machine shop, 72 feet wide by 172 feet long; and a "washing room," 74 feet wide by 182 feet long, and two stories high. The works will be the largest of the kind in this country.

FROM the following advices from Jefferson City, Mo., we infer that the local Gas Company is seriously considering the matter of engaging in the supply of electric currents. In any event our correspondent says: "The franchise of the Jefferson City Gas Company will expire Nov. 25, 1891, and it is likely that the Company will ask for an extension. A great many changes have taken place in Jefferson City since 1871, and many things that were all right then are out-of-place now. For instance, an experience of 19 years has established the fact that the

moon cannot be depended upon to illuminate the streets at night when the almanac indicates that it should. In spite of public feeling, cloudy nights interfere with the arrangement, and inky darkness in the city is the result. Public opinion is to the effect that a mixed system of electric and gas illumination would best serve our needs, and that some of the lights, especially in certain sections, should be maintained each night and all night. The Gas Company has given us good service, and has maintained its contract to the very letter. Therefore, if a mixed system is to be followed, you can safely predict that the Gas Company's claims to recognition will be the first to be passed upon.—R. T."

THE decision of the Quincy (Ills.) Gas Company to sell gas for cooking and heating purposes at $1 per 1,000 is keeping Manager Littleton on the jump. His orders for stoves have averaged 5 a day since the notice of the concession was published.

MESSRS. HELME & MCILHENNY report a very busy season just now, particularly in respect to station meters. Their contracts for these include the following:

Name of Company.	Size of Meter.
Denver, Col	12 ft. by 12 ft.
Detroit, Mich	13 ft. by 13 ft.
Citizens, Newark, N. J	9 ft. by 9 ft.
Grand Rapids, Mich	11 ft. by 11 ft.

WE are pleased to say that the damage to the plant of the Greensburg (Pa.) Gas Company—a fire occurred there about a fortnight ago—was very much less than that reported by the Associated Press. Gas making was suspended for only two days.

THE new plant of the Lake Erie Engineering Company, at Buffalo, N. Y., will be one of the finest in the country devoted to like purposes. The machine shop will be 108 feet wide by 185 feet long, and the foundry building will be of equal width and 225 feet in length. The buildings will be of iron from designs furnished by Mr. F. Felkel, civil engineer and architect, Cleveland, O., and are to be erected by the Berlin Iron Bridge Company, of East Berlin, Conn. The understanding is that the structures will be completed and ready for occupancy by January 1st, which would seem to be a very short time considering the magnitude of the undertaking.

AT a special meeting of the Halifax (N. S.) City Council the following action is reported in respect to the public lighting. The following tenders were submitted: W. B. Ross, of Ross, Sedgwick & McKay, for the Thomson-Houston Electric Company, of Montreal, offered to supply 208 electric arcs (1,200-candle power) for $70 per lamp per annum, and the same number of 2,000-candle power arcs, at $76 per lamp—all the tenders, it should be said, are on the basis of a moonlight table. The Halifax Gas Light Company offered to supply 500 arc lamps in the center of the city, and 500 gas lamps in the remaining district, the contract to run for five years, for the sum of $17,500 per annum. E. F. Clements, for the Merchants Manufacturing Company, of Yarmouth, N. S., offered to supply 1,200 candle power arcs, at $68 each per year, and 2,000-candle power lights at $73 each per year. The Halifax Illuminating and Motor Company wanted $79 for 2,000-candle power arcs and $72 for the 1,200-candle power variety. A. Drysdale, attorney for the Eastern Electric Company, of St. John, N. B., bid $62 and $69, respectively, for the low and high power lamps. Ald. Pickering moved that the tenders be all sent to the Committee on tenders for their consideration, and to report to the next meeting of the Council. Ald. Mackintosh moved that the tender of the Eastern Electric Company being the lowest be accepted, and that they be notified to that effect. Ald. Pickering said that the Council was not bound to accept the lowest or any tender, and that a matter of so much importance should be thoroughly discussed by a committee before being acted upon. Ald. Hamilton being asked by Ald. Lyons, stated that the sum paid under the present contract was $57 per light, of 1,200 candle power. Ald. Lyons seconded the motion that the tender of the Eastern Company be accepted provided they furnish satisfactory securities. Ald. Keefe thought the course suggested by Ald. Pickering was the wisest one to pursue. The Council did not know who the Eastern Company were, and the city had already had enough experience of dealing with strangers and irresponsible people. Ald. Rushland thought it would be a pity to see the contract go into the hands of parties out of the city, considering former experiences of the city in that respect. A protracted discussion taken part in by half a dozen members of the Council ensued as to whether the matter could or should be finally disposed of at the meeting. After a number of suggestions as to the mode of procedure had been ruled out of order, the opinion of the Recorder was asked for and given, he ruling that if any member objected to its being disposed of then, the matter would have to take its usual course on the order of the day for next meeting. The tenders, therefore, went on the order of the day.

APPLICATION has been made for a charter for the New Brunswick Electric Company, of St. Johns, New Brunswick.

THE new casting shop of the Midvale Steel Company will be designed and built by the Berlin Iron Bridge Company. The building will be 135 feet in width by 285 feet in length, and will be constructed entirely of iron, from the plans of the Berlin Company. The two wings of the house are to be 50 feet wide, and through the center of the building, for its entire length, provision has been made for the installation of two 50-ton traveling cranes.

AT the annual meeting of the Jamaica Plain (Mass.) Gas Light Company, the following officers were chosen: President, Francis A. Peters; Secretary and Treasurer, Geo. W. Kenyon; Directors, Francis A. Peters, Chas. F. Curtis, Andrew S. Peters, Prof. Chas. H. Wing, Edwin A. Hildreth, Fred. Seaver and Eugene N. Foss; Auditors, Stanley B. Hildreth and Nathaniel J. Rust.

THE Selectmen of Hull, Mass., have granted a franchise to the proprietors of the Nantasket Electric Light and Power Company, who propose to illuminate Nantasket Beach with arc lights. The originators of the scheme are Messrs. Elisha Thayer, C. T. Harrington, A. W. Hastings, Geo. Davis and Geo. A. Smith.

THE proprietors of the Jamaica Plain (Mass.) Gas Light Company have voted to extend their mains in the direction of the adjoining district of West Roxbury.

THE United Gas Improvement Company, as lessees of the gas system at Jersey City, N. J., are making notable improvements in the capacity and extension of their distributing pipes. For instance, and to show the magnitude of the changes, a 10-inch main is being run through Palisade avenue, etc., to relieve what is known as the Fourth district, the length of which will be 3 miles. It replaces a 3-inch main.

MR. A. W. PARKS has applied to the Selectmen of the town of Holbrook, Mass., for a franchise for a Gas Company for that place. Holbrook, which was formerly known as East Randolph, is a post village of Norfolk county, Mass., at a point on the Old Colony Railroad, 15 miles south of Boston.

THE Kingsville (Ont.) Town Council has agreed to loan to the Citizens Gas Company the sum of $15,000 for the purpose of enabling the latter to lay its mains through the town.

THE authorities of Buffalo, N. Y., are considering the matter of installing and operating on public account an arc lighting plant.

AT a meeting of the Cincinnati (O.) Board of Public Improvements, President Reemelin offered the following, which was adopted:

Resolved, That the Solicitor be requested to give this Board an opinion on each of the following questions: 1. Has the Cincinnati Gas Light and Coke Company an exclusive franchise to furnish illuminating gas in the city of Cincinnati and to the streets of this city for the same purpose? 2. Has the city of Cincinnati the right to buy said Gas Company's works and pipe lines, and if so, what steps can this Board take to carry into effect such right of purchase? 3. Can this Board advertise for bids for illuminating gas in Cincinnati and award to the best and lowest bidders and then prepare an ordinance inserting such successful bidders names therein, and approve and transmit the same to Council; having in said ordinance a provision that such ordinance shall only take effect when submitted to a vote of the people and ratified by them.

THE St. Louis *Globe-Democrat*, in referring to a contract recently made for the disposal of its entire coke product by the Laclede Gas Company to a local firm, says: Many of the manufacturing concerns in St. Louis have been using coke in their furnaces for several years, and while much of the material has been furnished by the Laclede Gas Light Company, an equal or greater amount has been brought here from Connellsville. Not fearing competition from the latter source, Mr. Edward Devoy, of the firm of Devoy & Feuerborn, states: "Although we do not think there is much money in the coke trade, still we will not permit any one to undersell or get the better of us in the business. We have, therefore, secured such a quantity of coke as to be able to supply all

consumers, small or large. It is also our intention to push the coke trade for all it is worth, and to show people that they will save a fine sum by using it. There are 57 bushels of coke and 25 bushels of hard coal to the ton. Every pound of coke is equal to a pound of coal to consumers when the draughts of the fires are properly regulated. Coal is now selling for $7.25 a ton, and coke at $5.75; therefore it may be plainly demonstrated why coke may be suitably substituted for coal. We trust before the winter is half over to make a most notable hole in the anthracite trade, not only as far as manufacturers are concerned, but as to private consumers as well. Coke is now being used pretty generally by the manufacturers, but private consumers have invariably preferred the hard coal. The latter fail to use the substitute we are suggesting simply because of the extra trouble in keeping the fires burning. When once the coke becomes ignited it is bound to burn out when the drafts of the stove are not properly adjusted, but with a little care all this can be remedied, and the coke will burn as long and consistently as hard coal. The difference in the price will be a sufficient inducement for people to discard hard coal and to take the extra trouble in burning coke in their stoves. In the preparation of coke the 4 sizes will be made to correspond with the egg, stove, No. 4, and chestnut coal, so that consumers can always be supplied with the size they desire and have been accustomed to use in their stoves." Although the price of coke to private consumers has been fixed at $5.75 a ton, to manufacturers and the larger trade the price will be considerably less. Certain factories that are in the habit of ordering 100 tons or more at a time will have the advantage of purchasing it for something like $4.75 a ton delivered, or even less than that figure when the factory owners have their own carting done. Hereafter Devoy & Feuerborn will exclusively regulate the prices of coke, and will not be affected in the least, it is thought, by Connellsville or other outside competition. They will have such a large amount always on hand and will have secured it at such low figures as to enable them to dictate the prices. They promise that coke will be sold at no higher than the present figure, $5.75 a ton, and if any change in the prices is to be made the trade will have the better of it. Coal dealers generally do not anticipate any falling off in their hard coal orders on account of the substitute, but are willing to confess that coke is rapidly coming to the front as far as the manufacturers are concerned.

A RECENT issue of the Pittsburgh (Pa.) *Press* contains the boast that the gas lamp posts in that city—now disused because electricity is depended on to furnish light—are going to pieces rapidly; that the boys break the glasses with impunity, and so on. This would seem to be a confession of incapacity on the part of the police authorities, who, in Pittsburgh, we presume, as elsewhere, are paid to protect the property of citizens. In fact, in the article referred to, we find it stated that Commissioner Bigelow, of the Department of Public Works, when asked as to who was caring for the lamp posts, replied; "I don't know. The city has nothing to do with them now. The contract is up with the Gas Company, but as it was only paid for the light, we have nothing to do with caring for its property. It is its own lookout. Should we have to go back to gas again, the Company would be required to put every lamp in order." If that is not a bald admission, we would like to know why. Hoodlums can destroy the Company's property at will, simply because the authorities will not interfere to protect it.

Practical Nationalism in Chicago.

The following, contributed by Charles L. Weeks to the *Nationalist*, shows the views of an extremist, and also proves how weak their arguments are. Mr. Weeks' speculations on candle power are particularly amusing. He writes:

No better object lesson can be found by which to teach first steps in nationalism than the progress which Chicago is making toward performing its own public service.

Our municipal electric lighting system is now nearly three years old, and none but good results have appeared. Among them are excellence of service, economy of management, and freedom from that corruption which is too often the odious adjunct of public service performed by private corporations. But most gratifying of all is the revelation to the people that, by venturing into this field, they have learned how to apply the true principles upon which to supply their own needs. This discovery has already borne fruit. Our Mayor's recent message recommends that the city supply to the citizens light for household purposes, also heat, power and street car transportation, at cost, as it now supplies water; and he predicts that such improvements are among the probabilities of the near future.

Chicago has taught some valuable lessons to other cities which would establish electric light plants, among them that it is not only practicable but advisable to make a small beginning. Our first investment was but about $12,000, and our first plant was fitted up to run fewer than 100 lamps. To this additions of engines and dynamos were made from time to time, and the number of lamps increased. At this time we have three very substantial plants in operation. They have been built under the direction of our city electrician, Prof. Barrett, and are equipped with the latest and best appliances. The capacity for each is for 1,000 arc lamps of 2,000-candle power each. One hundred and sixteen miles of wire have been laid in underground conduits. Many miles of streets in addition have been piped, and are ready for the wire as soon as other construction has been completed.

We have in nightly operation 668 lamps of 2,000-candle power each. The construction is being rapidly pushed, and 500 more lamps will be burning by the coming fall.

Our system is said to be the best extant. No wires are exposed in the streets; all are underground, and the connection with lamps is made by running the wires up through the lamp posts. There has been no instance of injury to life or property, nor can there well be from the safeguards provided.

Our cost of operation, under favorable circumstances, will not exceed $50 per lamp of 2,000 candle power per year. At present the cost somewhat exceeds that; this is because the plants are not yet being run to their full capacity, and because the territory covered is many times greater than would ordinarily be the case with the number of lamps now operated. Economy would bring the present number of lamps into a territory one-fourth that now covered. But Professor Barrett is between two fires; on the one hand the people, through their aldermen, are clamoring for the extension of the system beyond his present means; on the other hand, the Gas Trust and private electric light companies, through *their* aldermen, are throwing obstacles in his way, even to demanding that he perform impossibilities, in the hope of compelling a bad showing. If he could be allowed to do his work free from harassment by those who would purposely make it difficult, he could get better immediate results as to cost of operation.

When the system is complete, the running expenses will be very much less than now. The same buildings and corps of attendants could, with slight additional outlay, supply several times the number of lights now produced. The saving over gas in lighting our streets by electricity, even under present unfavorable conditions, is enormous. We now pay $20 per year per gas lamp of 20-candle power, or $1 per year per candle power. Our present cost per candle power for operating electric lights is less than four cents per year, and when our plants are running to their full capacity it will not exceed 2½ cents as against $1 for gas.

Cities have been led into making contracts with private electric lighting companies at enormous prices because of two things: 1st, their entire ignorance of the cost of such service; 2d, the belief that to establish an electric light plant was an undertaking on a par with the putting in a gas plant or building a water works system. The facts are becoming known; cities and towns are discovering that it is a very simple and inexpensive thing to own and operate their own electric light plant.

More than 20 cities in this country have already established electric light plants, and are supplying their street lamps at a cost of $50 or less per year per lamp, while many other cities are paying to private corporations from $150 to $200 per year for the same service. Until recently Boston has been paying $240 per year per lamp.

A plant for 100 arc lamps can be put in full running condition for $15,000, exclusive of land and buildings. Many towns have these latter that can be used without much delay. The cost per lamp for operating a 100-lamp plant would be about $65 to $70 per year. With 300 lamps the cost would be reduced to $60 per year.

A simple beginning, and one within the reach of any town, would be to put a 25 or a 50-light dynamo into the basement of some public building which it was desired to light; then connect with other city buildings and have a few lamps in the streets between. A commencement of this sort would soon be extended by popular demand. Started in this way a plant for 50 arc lights need not cost over $8,000.

A favorite objection to the extension of such service as this is that it would increase the danger of corruption. Chicago's experience has been that the corruption has come chiefly from corporations operating its public service. It is true some of our statesmen thought they could steal; but we were able to *go over their accounts*, and they are now serving the State in a capacity more in keeping with their ability.

A most striking instance of the corrupting influence of corporations in Chicago has been within the experience of this same Professor Barrett. Eight or nine years ago he made an attempt to establish an electric light plant. As a beginning he procured a small dynamo and connected it to an engine in the water works pumping house. He established a number of lamps in the building and on the water tower. The gas company began to fight the enterprise at once, and an order was soon forthcoming from the City Council directing the Professor to sell that dynamo, which he did, and his lights had to come down. Had he been permitted to go ahead, he would have saved Chicago two or three million dollars before this time on street lighting alone.

The chief opposition to our present undertaking comes from the Gas Trust and private electric lighting companies here. But, thanks to the perseverance of Professor Barrett, our system is daily being put on a more secure basis, and is now in no danger of being overturned.

There is no reason why every city in the land should not follow Chicago's example, and provide its own service of this character. If private corporations can pay taxes, insurance, water rates, fancy salaries, and big dividends out of such service, then surely the people can perform it for themselves when they have none of these things to pay.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

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AGENTS.
NEW YORK.—AMERICAN NEWS Co., 39 and 41 Chambers Street.
Germany.—B. WESTERMANN & Co., of New York.

MONDAY, SEPTEMBER 22. 1890.

The Market for Gas Securities.

Financiers claim to see their way clear to easier money, which will, of course, take the pressure off the stock market. It is notable, however, that the securities which held up to values best during the time of stringency were the various gas shares, save Chicago gas, which was sold down to 40, on rumors that the disagreement with the city was assuming a really serious phase. To-day (Friday), however, Chicago is up to 46¼, and it ought to be 10 points higher if intrinsic worth were the basis of rating. Consolidated is at 96 to 96¼. The prevailing feature in the general market is dullness. Investors will soon have opportunity to bid on 2,000 shares of new stock in the Worcester (Mass.) Gas Company, the issue to go to the purchase of the local electric lighting company.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks,

16 WALL ST., NEW YORK CITY.

SEPTEMBER 22.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	96	96½
Central	500,000	50	90	100
" Scrip	220,000	—	95	100
Equitable	4,000,000	100	124	127
" Bonds	1,000,000	—	113	115
Harlem, Bonds	170,000	—	—	—
Metropolitan, Bonds	658,000	—	115	—
Mutual	3,500,000	100	120	—
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern	.....	50	—	—
" Bonds	150,000	—	—	100
Standard Gas Co—				
Common Stock	5,000,000	100	40	45
Preferred	5,000,000	100	85	90
Yonkers		50	112	—
Richmond Co., S. I.	346,000	50	—	—
" Bonds	20,000	—	—	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	120	123
Citizens	1,200,000	20	95½	96½
" S. F. Bonds	320,000	1000	100	103
Fulton Municipal	3,000,000	100	140	143
" Bonds	300,000		100	105
Peoples	1,000,000	10	95	98
" Bonds (7's)	368,000	—	100	—
" " (6's)	94,000	—	100	—
Metropolitan	1,000,000	100	109	111
Nassau	1,000,000	25	130	—
" Ctfs	700,000	1000	100	102
Williamsburgh	1,000,000	50	131	—
" Bonds	1,000,000	—	108	112
Out of Town Gas Companies.				
Boston United Gas Co.—				
1st Series S.F. Trust	7,000,000	1000	93	93½
2d " " "	3,000,000	1000	71	72
Bay State Gas Co.—				
Stock	5,000,000	50	78	80
Income Bonds	2,000,000	1000	95½	—
Buffalo Mutual, N. Y.	750,000	100	90	95
" Bonds	200,000	1000	95	100
Citizens, Newark	1,000,000	50	155	160
" " Bonds.	45,000	—	—	—
Chicago Gas Company.	25,000,000	100	46¼	46½
Chicago Gas Light & Coke Co.—				
G't'd Gold Bonds	7,650,000	100	—	92½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1000	—	98
People's Gas and Coke Co., Chicago—				
1st Mortgage	2,100,000	1000	—	100
2d "	2,500,000	1000	94	98½
Consumers Gas Light Co., Jersey City	2,000,000	100	20	—
Bonds	600,000	1000	80	—
Cincinnati G. & C. Co.	6,000,000	100	201	203
Consumers Toronto	1,000,000	50	190	200
Central, S. F., Cal			80	90
Capital, Sacramento, Cal			58	
Consolidated, Balt.	11,000,000	100	50⅜	50¾
" Bonds	6,400,000		107	107½
Citizens Gas Lt. Co., Rochester, N. Y.	500,000	—	85	110
Bonds	250,000		—	—
Hartford, Conn	750,000	25	102	108
Jersey City	750,000	20	170	175
Louisville, Ky	2,570,000	50	125	130

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This gas can be furnished at a cost less per 1,000 cubic feet than the coal gas may be costing the company.

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This is much less per candle power than it can be furnished by the use of cannel coal or by vaporizing naphtha. With our process we improve the whole output in color—viz., whiten the flame with the oxygen, as well as furnishing a *thoroughly fixed* gas, and no possible danger of separation as there is with vapor.

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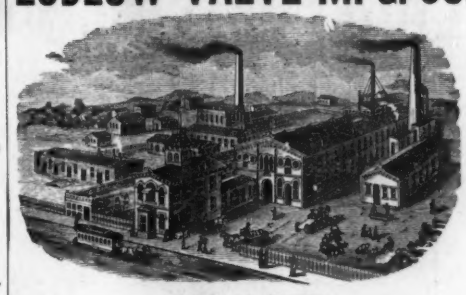

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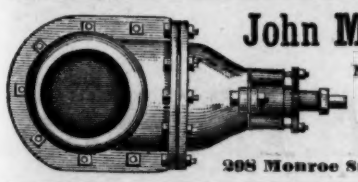

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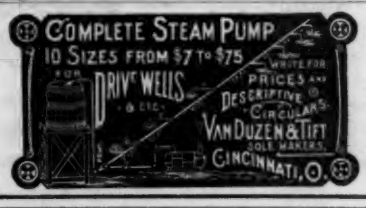

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The Eighteenth Annual Meeting of the American Gas Light Association

Will be Held at Savannah, Oct. 15, 16, and 17.

HEADQUARTERS AT THE DE SOTO.

Parties wishing to join the Association must send in their application at least ten days prior to the meeting. Parties engaged in business relating to the Gas Industry are eligible as Associate Members. Application blanks may be obtained of the Secretary, C. J. R. HUMPHREYS, Lawrence, Mass.

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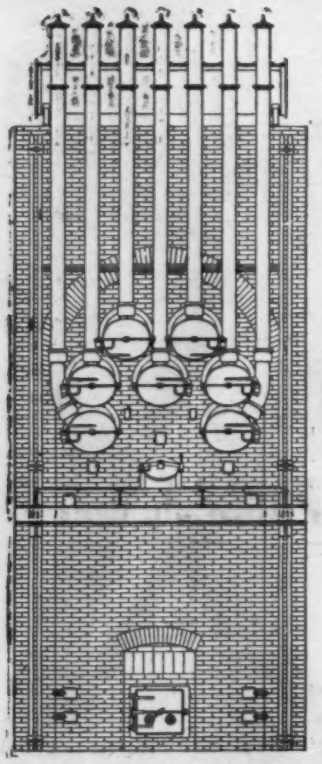

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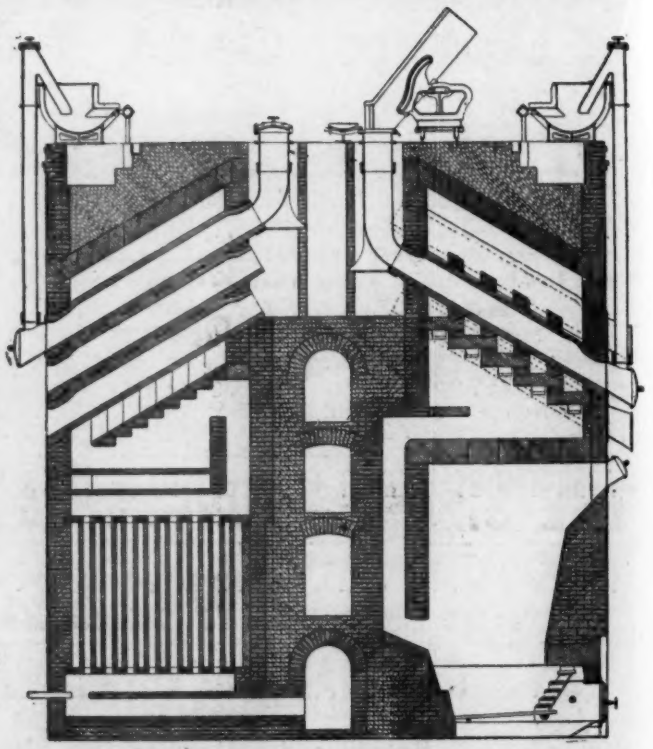

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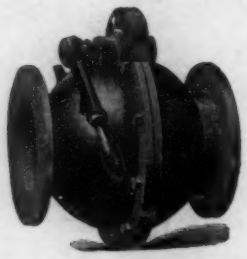

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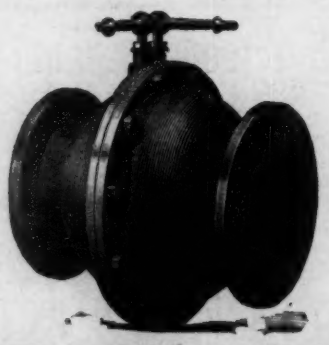
Efficient, Durable.



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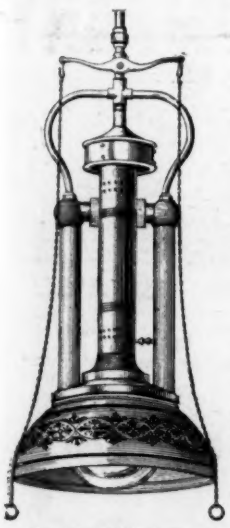
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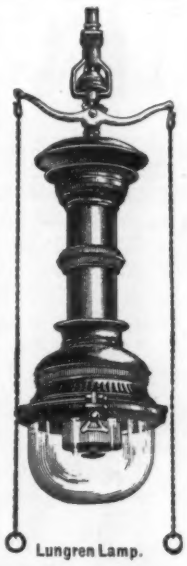
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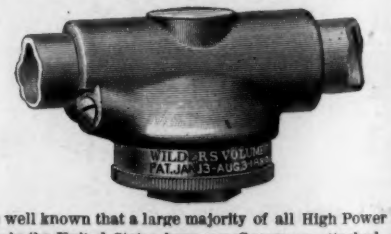

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Correspondence Solicited with all who require a Reliable Governor.

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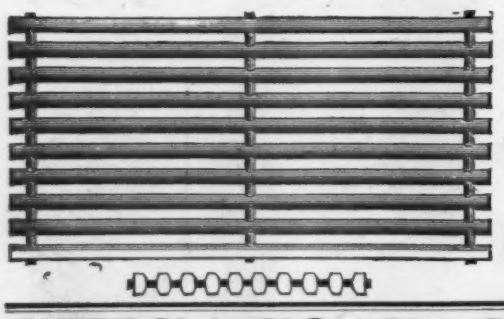

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MANUFACTURED BY

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157 & 159 Superior Street, - Chicago, Ill.

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Experimental Meters of all Kinds,

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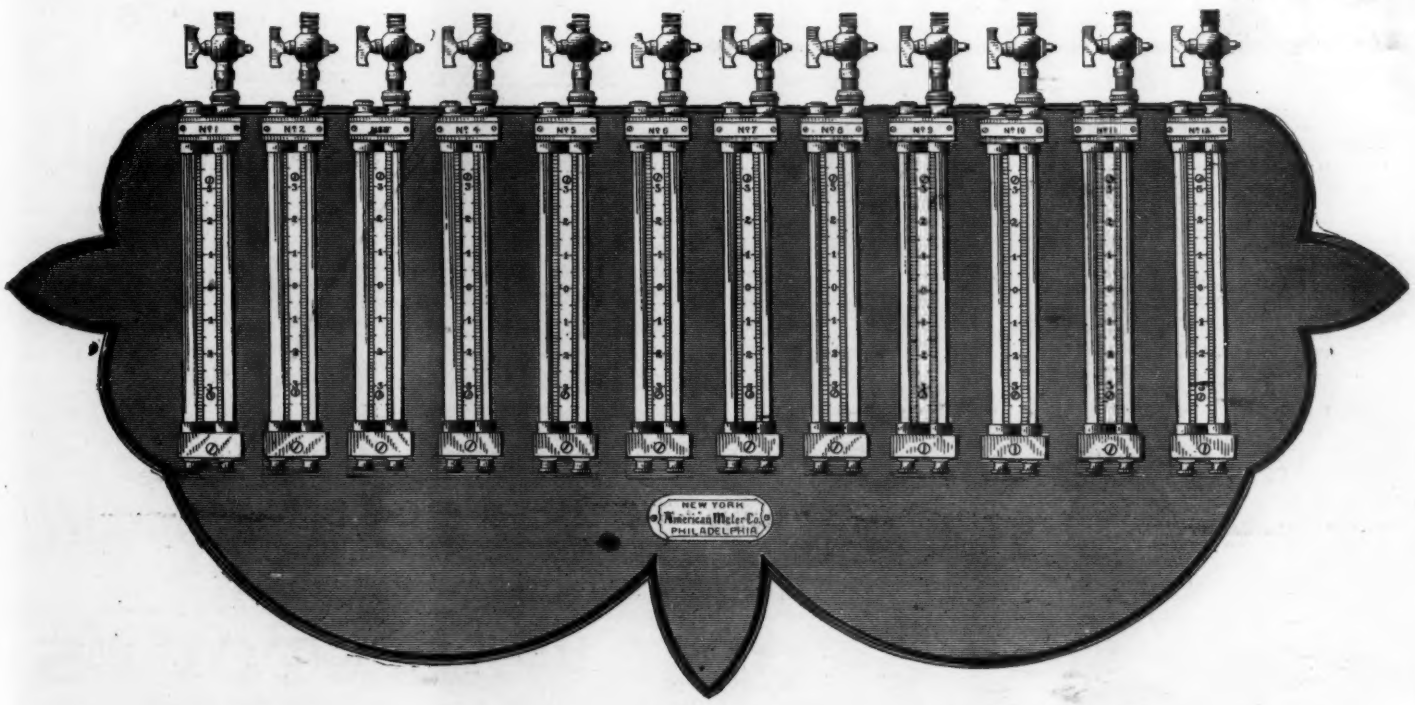

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PATENT "STANDARD" WASHER-SCRUBBERS

Erected and in course of construction at present date:

	Capacity. Cubic feet per day.
Altrincham	600,000
Adelaide	600,000
Aldershot	200,000
Allegheny, U. S. A.	1,000,000
Ashton-under-Lyne	1,250,000
Amsterdam	1,500,000
"	1,500,000
Annaberg	200,000
Arcachon	100,000
Animal Charcoal Co	200,000
Altoona, U.S.A.	350,000
Buxton	250,000
Bradford	1,000,000
"	1,250,000
"	1,250,000
"	1,250,000
"	1,000,000
"	1,000,000
"	3,000,000
Bremen	150,000
Baltimore, U.S.A.	1,000,000
"	1,000,000
"	1,000,000
Balmain, N.S.W	125,000
Bishops Stortford	150,000
Blackpool	400,000
Brussels	1,250,000
"	1,250,000
"	750,000
"	1,250,000
Banbury	250,000
Birmingham	5,000,000
Birkenhead	2,500,000
Blackburn	1,500,000
Bochum	600,000
Burntisland	250,000
Boston, U.S.A.	2,000,000
Brisbane	1,500,000
"	300,000
Burton-on-Trent	1,500,000
Barcelona	350,000
Barking	100,000
Baerlien & Co	20,000
"	20,000
Bombay	400,000
Buffalo, U.S.A., Mutual	750,000
" Citizen	500,000
Brookline, U.S.A.	500,000
Bergen	350,000
Berlin	1,250,000
Bournemouth	1,000,000
Bridgeport, U.S.A.	500,000
Brunswick	300,000
Beck & Co., St. Louis	100,000
Barmen Rittershausen	600,000
Bexhill	125,000
Brooklyn, U.S.A	1,000,000
"	1,000,000
" Nassau	1,000,000
Brunner, Mond & Co.	400,000
Cheltenham	2,000,000
Cannes	200,000
Croydon	1,500,000
Copenhagen	200,000
Clevedon	200,000
Columbus, U.S.A	500,000
Cincinnati, "	1,500,000
" "	1,500,000
Chicago "	3,000,000
" "	1,000,000
" "	1,000,000
Chemnitz	1,000,000
Crewe	1,250,000
Colonial Gas Works Co	100,000
Cadiz	300,000
Charlottenburg	600,000
Dudley	750,000
Driffield	100,000
Dukenfield	500,000
Dover	750,000
"	1,000,000
Deal	200,000
Derby	1,500,000

	Capacity. Cubic feet per day.
Dublin	3,000,000
Dowlais	100,000
Douai	500,000
Denton	500,000
Derby, U.S.A	350,000
Denver, "	500,000
" "	1,000,000
Dusselldorf	750,000
"	500,000
Dumfries	250,000
Dunedin, N.Z	400,000
Darlington	1,250,000
Detroit, U.S.A	750,000
Edinburgh	1,500,000
"	2,000,000
Enfield	300,000
Essen	300,000
Elbing	150,000
Falmouth	150 000
Frankfort	300,000
Farnworth	400,000
Fenton	400,000
Friedenshutte	500,000
Furth	400,000
Freiburg	200,000
Goole	250,000
Glossop	300,000
Guildford	300,000
Gloucester	1,250,000
Gera	300,000
Grafton, N.S.W	100,000
Grieg	300,000
Georgetown, U.S.A	250,000
Gluckauf	200,000
Heywood	600,000
Holywood	125,000
Huy	70,000
Harrow	250,000
Harrogate	250,000
Halstead	150,000
Heilbronn	200,000
Havana, Cuba	750,000
Hastings	1,500,000
Huddersfield	300,000
"	750,000
"	1,500,000
Hof	200,000
Hampton Wick	500,000
Heckmondwicke	500,000
Haverfordwest	100,000
Halifax, N.S.	350,000
Hamm	200,000
Halle	400,000
Heidelberg	300,000
Hartford, U.S.A	1,000,000
Ilkeston	300,000
Inverness	250,000
Ilkley	200,000
Ilford	100,000
Kingston-on-Hull	400,000
Kidderminster	750,000
Kidsgrove	100,000
Konigberg	1,000,000
King's Lynn	300,000

LONDON:—

The Gaslight and Coke Co.:	
Beckton	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	2,500,000
"	2,500,000
Silvertown	1,000,000
Bromley	2,000,000
"	1,500,000
"	1,500,000
"	1,500,000
"	2,000,000
"	1,500,000

LONDON—*Continued.*	Capacity. Cubic feet per day.
Shoreditch	2,500,000
Pancras	1,500,000
"	1,500,000
Pimlico	2,000,000
Nine Elms	3,000,000
"	3,000,000
South Metropolitan Co:—	
Greenwich	3,000,000
Woolwich	400,000
Vauxhall	3,000,000
"	3,000,000
Lea Bridge	300,000
West Ham	1,500,000
Leeds	2,000,000
"	3,000,000
"	3,00 ,000
"	3 000,000
"	3,000,000
"	2,000,000
Leominster	150,000
Leiden	560,000
"	600,000
Liverpool	2,000,000
"	2,000,000
"	2,000,000
"	2,000,000
"	2,000,000
"	3,000,000
Lincoln	1,000,000
"	600,000
Lowell, U. S. A	1,000,000
Louisville "	1,500,000
Long Eaton	500,000
Lilie	900,000
"	450,000
"	750,000
"	250,000
"	250,000
Luckenwalde	330,000
Liegwitz	300,000
Lincoln, U. S. A	250,000
Lawrence "	500,000
Lynn "	300,000
Lyons	1,500,000
Maidstone	1,000,000
Marseilles	1,500,000
"	1,500,000
Mons	500,000
Malines	250,000
Melbourne	1,500,000
"	1,500,000
"	1,500,000
"	1,500,000
"	1,500,000
Manchester	2,500,000
Middleton	400,000
Manley, N. S. W.	100,000
Minneapolis, U. S. A	750,000
Magdeburg	300,000
Memphis, U. S. A	750,000
Nottingham	1,250,000
"	2,500,000
"	2,500,000
"	2,000,000
"	1,500,000
"	2,000,000
Newport, U.S.A	430,000
Newmarket	150,000
Newark, U.S.A	680,000
Northfleet	200,000
New York, U.S.A	2,000,000
Nice	600,000
Newcastle, N. S. W.	200,000
Numea, "	100,000
Namur	250,000
Newark	350,000
Oldbury	500,000
Otley	200,000
Oswestry	250,000

	Capacity. Cubic feet per day.
Ober Schlesian	1,500,000
Otto & Co.'s Coke Works	1,500,000
Plymouth	2,000,000
Parramatta, N. S. W	100,000
Prescott	150,000
Providence, U.S.A	750,000
"	750,000
Plauen	300,000
"	300,000
Portsmouth	2,500,000
"	2,500,000
Pittsburgh, U.S.A	1,500,000
Portland, "	560,000
Pawtucket, "	500,000
Quebec	250,000
Radcliffe	750,000
Rouen	250,000
Ramsgate	1,000,000
Reigate	200,000
Richmond, U.S.A	250,000
Roxbury, "	500,000
Runcorn Soap Co.	20,000
Rockhampton, N. S. W.	125,000
Richmond	1,500,000
Reading	2,000,000
Reichenbach	200,000
Salford	1,750,000
"	1,750,000
"	1,750,000
Smethwick	750,000
Sydney, N. S. W	1,000,000
"	1,000,000
"	2,500,000
"	50,000
"	50,000
Sunderland	1,500,000
St. Josephs, U.S.A	250,000
Spa	100,000
Sevenoaks	300,000
St. Petersburg	2,000,000
"	1,500,000
St. Louis, U.S.A	2,000,000
"	2,000,000
"	1,000,000
Laclede	1,000,000
Silesian Coal Co.	600,000
San Francisco, U.S.A	2,000,000
"	2,000,000
Sheepbridge Coal Co.	40,000
Stettin	200,000
Singapore	300,000
Sutton	500,000
Tonbridge	150,000
Tipton	400,000
Tottenham	1,000,000
Toledo, U.S.A	750,000
Toronto	1,000,000
Uxbridge	300 000
Valparaiso	500,000
West Bromwich	1,000,000
Willenhall	250,000
Weston-super-Mare	500,000
Waltham	150,000
Wormwood Scrubs	300,000
Williamsburg, U.S.A	600,000
"	600,000
Wellington	150,000
Warwick	300,000
Wheeling, U.S.A	500,000
Walker	300,000
Westgate	100,000
Wilmington, U.S.A	500,000
Windsor, N. S. W.	100,000
Wolverton	100,000
Wellington, N. Z.	250,000
Whitchurch	175,000
Washington, U.S.A	2,000,000
Wallasey	750,000
Weimar	150,000
Wurzen	200,000
Worcester, U.S.A	750,000
Yeadon	500,000
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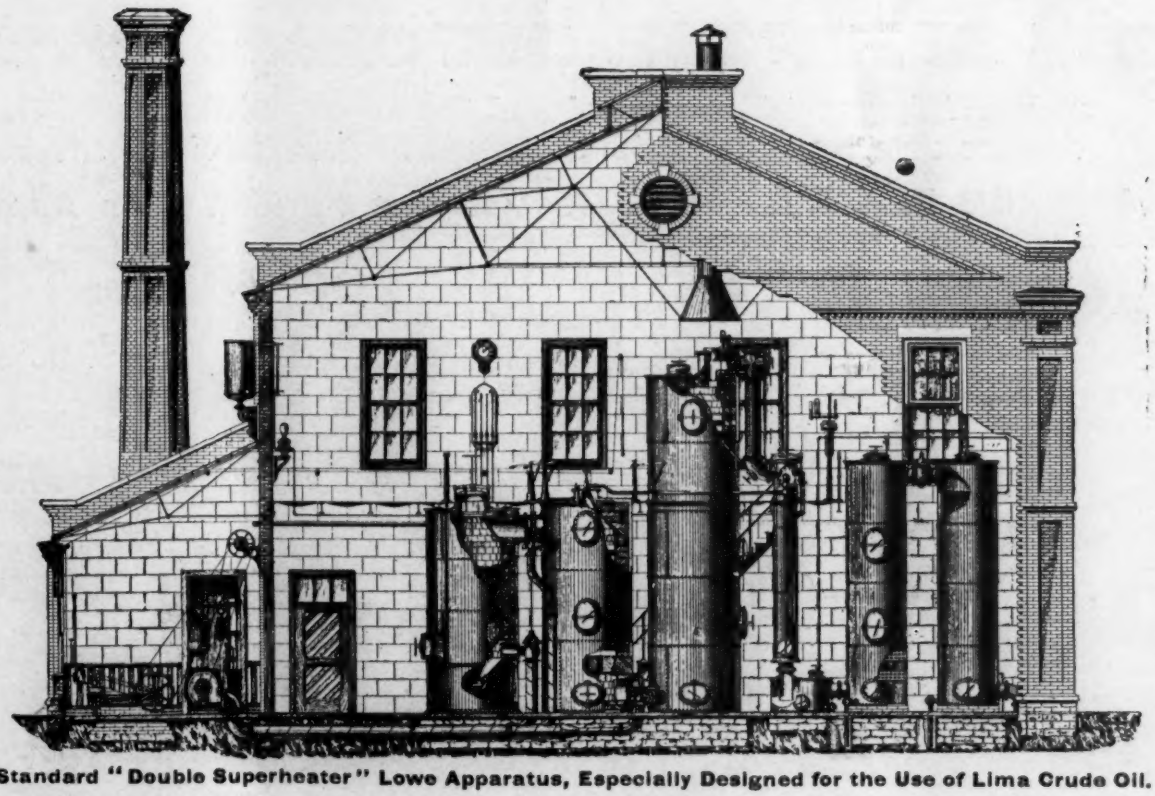

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USING LIMA OR OTHER LOW GRADE OILS AND ANTHRACITE COAL OR GAS HOUSE OR OVEN COKE.

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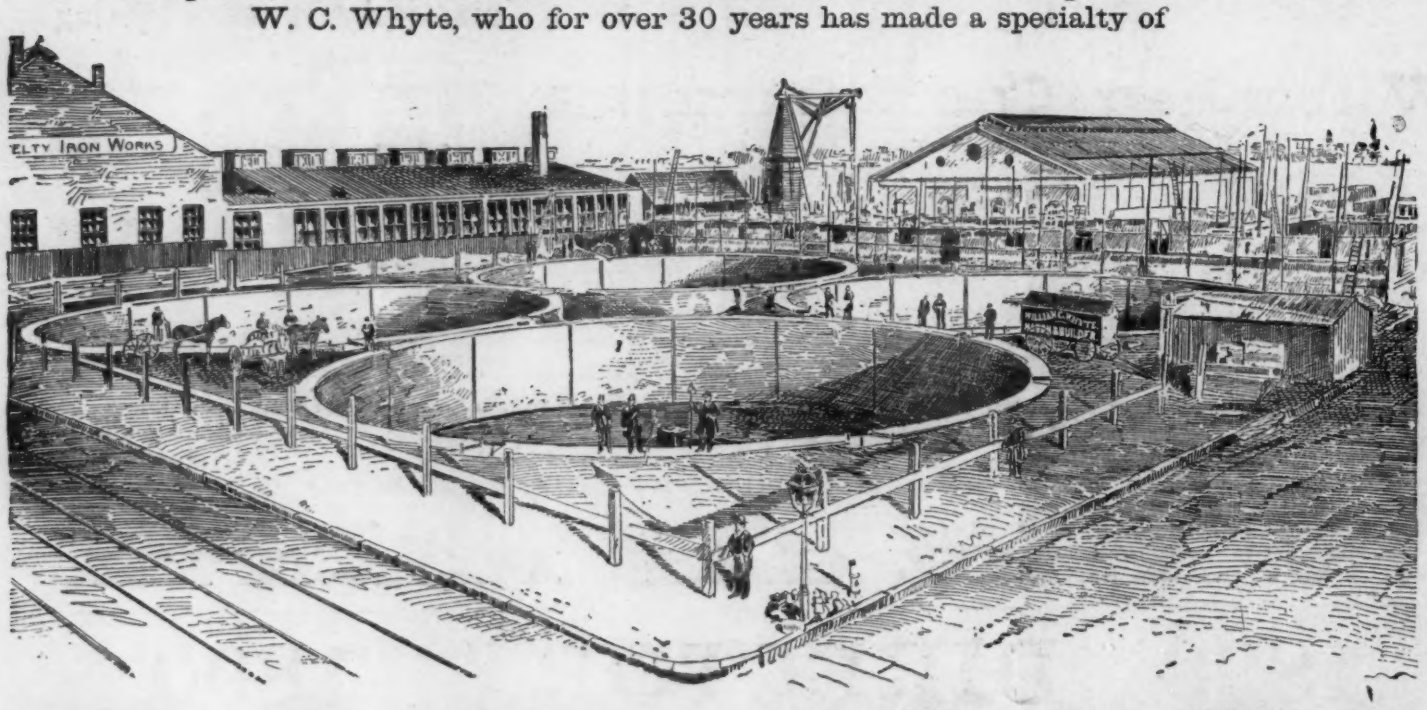

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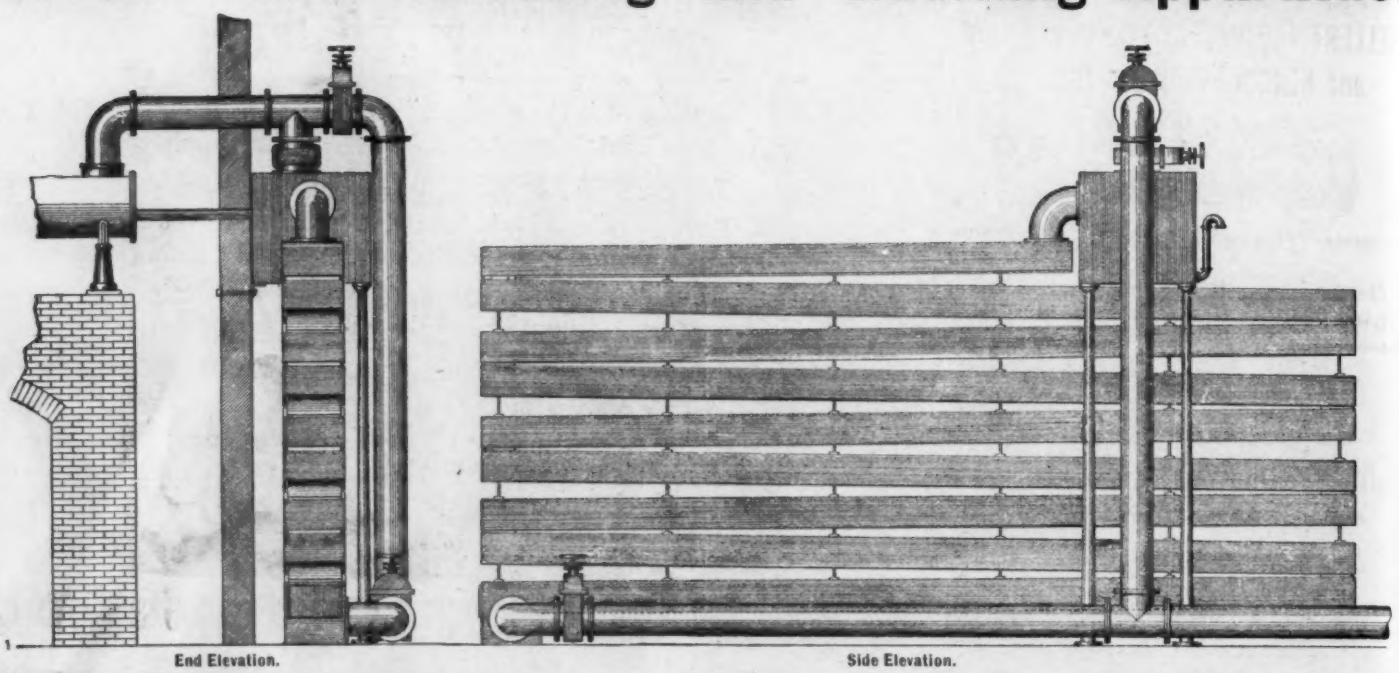

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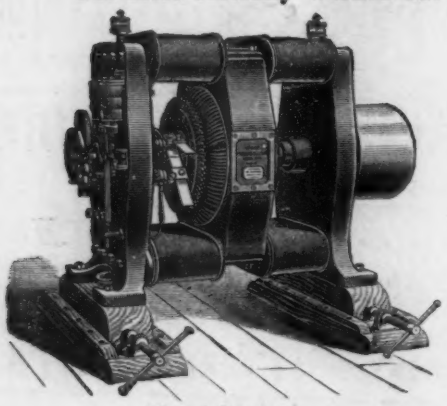

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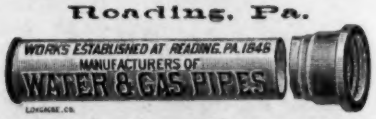

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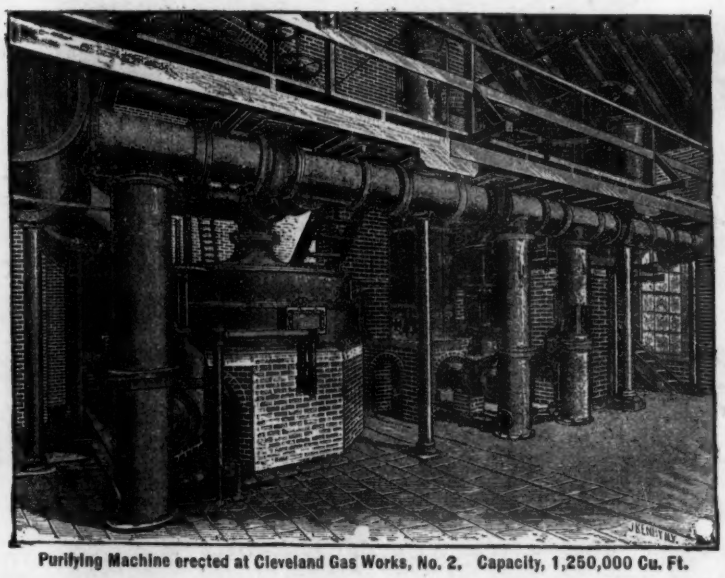

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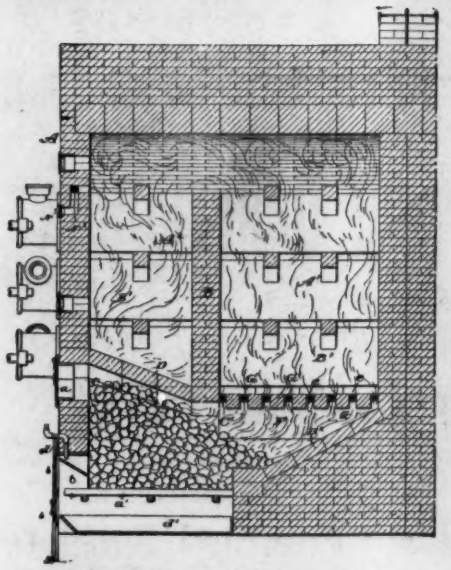

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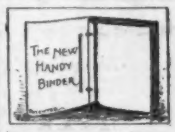

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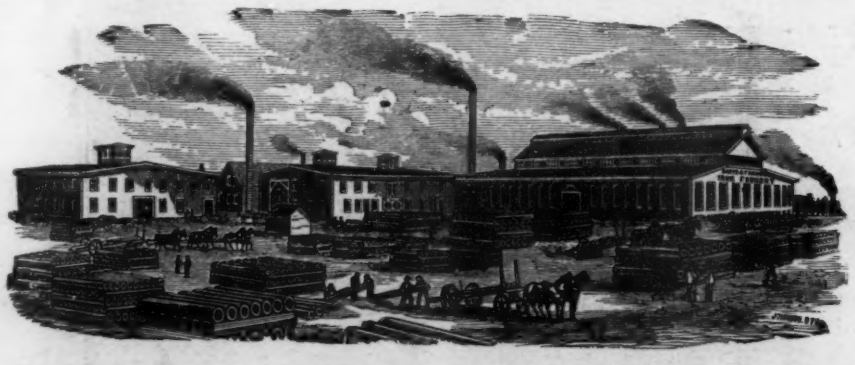

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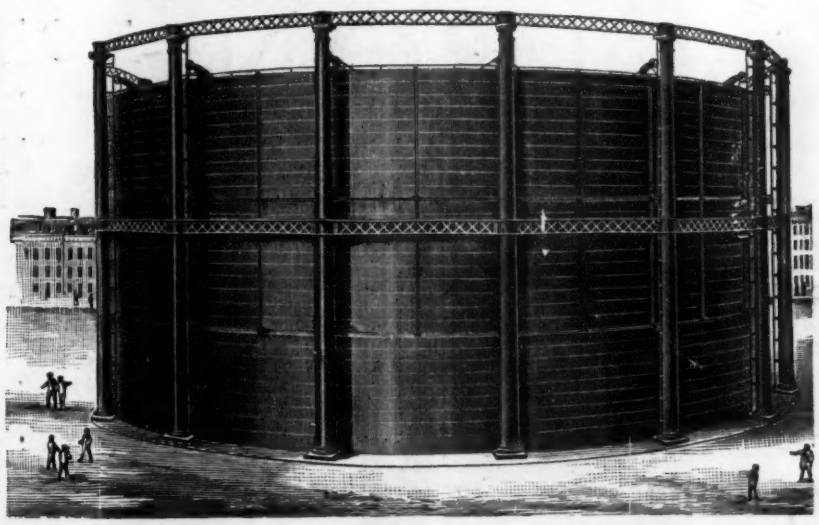

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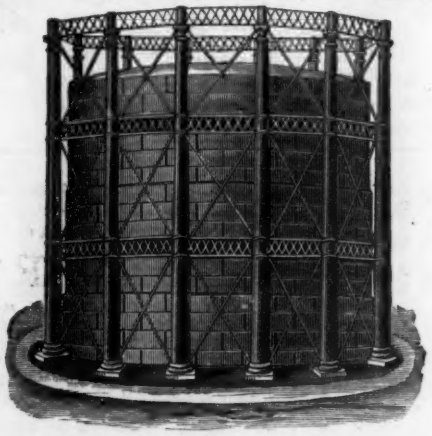

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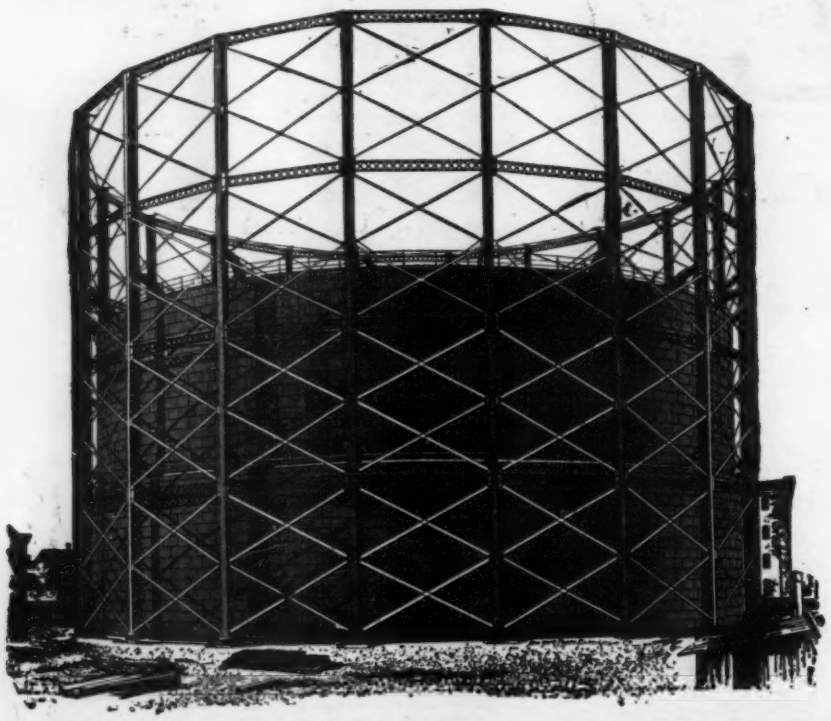

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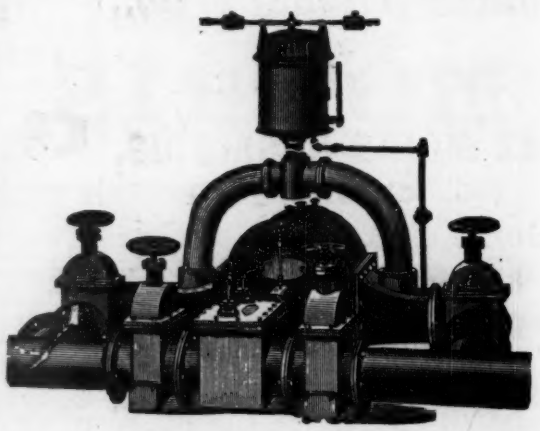

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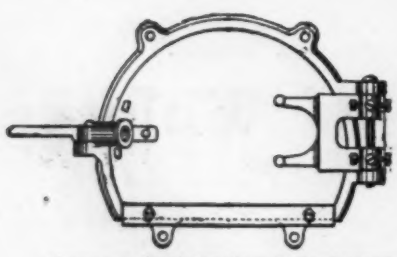

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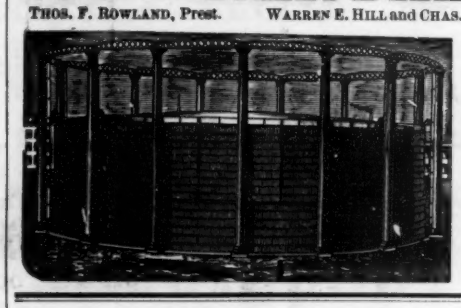

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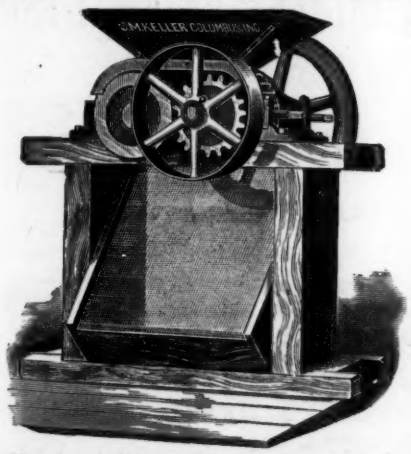

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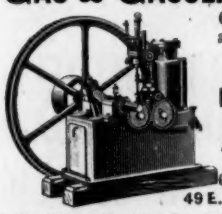

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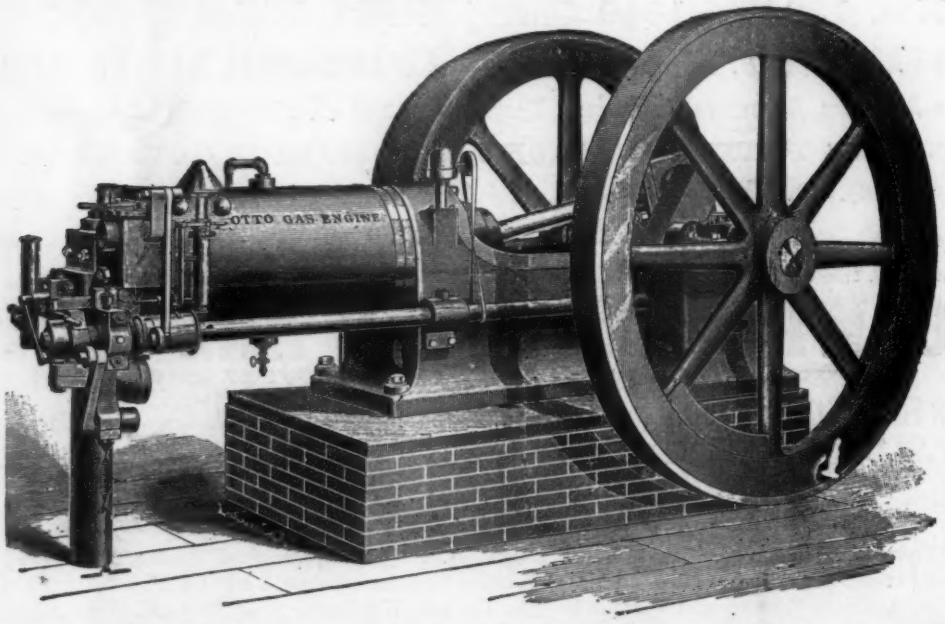

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